

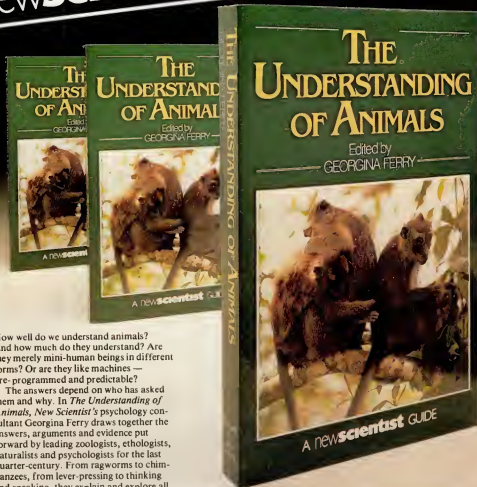
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FACTORY FARMERS COOK THE BOOKS



**Through a glass clearly
How schools misuse the micro**

newscientist GUIDES



How well do we understand animals? And how much do they understand? Are they merely mini-human beings in different forms? Or are they like machines — pre-programmed and predictable?

The answers depend on who has asked them and why. In *The Understanding of Animals*, *New Scientist's* psychology consultant Georgina Ferry draws together the answers, arguments and evidence put forward by leading zoologists, ethologists, naturalists and psychologists for the last quarter-century. From ragworms to chimpanzees, from lever-pressing to thinking and speaking, they explain and explore all aspects of animal behaviour.

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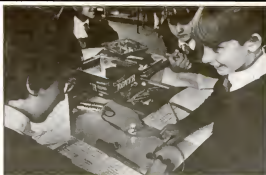
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Cover illustration by Chris Corr

NEXT WEEK

Working Africa's agriculture harder

Africa's development has bypassed the people who die in famines—those who grow their own food. Now that scientists are looking at ways of helping subsistence farmers, they find they have much to learn

Fractals on the road to infinity

General relativity stands the test of time

newscientist



Mike Cross

Industrious government

THE BRITISH government gains numerous points for trying its hardest to drag the country's industry screaming into the latter half of the 20th century. There are, though, various questions surrounding the initiatives designed to help industry to innovate and to provide the manpower for that innovation. But first let us look at the good news.

The government is redirecting £43 million from some of its departments to support 4000 extra places for people to study "relevant" technologies (This Week, p 8). Of this money, only £4 million comes out of the existing budget of the University Grants Committee. The other £39 million comes courtesy of the government departments with a direct interest in the industries that are said to be so short of technically qualified workers. The first bit of good news is that the government can find extra money when it wants to. The second bonus point is that the right people will be paying. For too long the Science and Engineering Research Council, to take one example, has, by encouraging engineering and technology at the expense of basic science, done industry's job with hardly a word of gratitude, but with significant criticism from its own constituency.

We could complain that if the companies really are so desperately short of technically competent workers they should themselves contribute something more than the "fills" of the seconded lecturers, donated equipment and attractive scholarships that they have all pledged. But any more determined move in the direction of industrial involvement would almost certainly have stronger strings attached. At least the extra money will be administered by the University Grants Committee; academia continues to run its own affairs.

The next episode in this good-news soap-opera is that the government has ended the moratorium on government grants for R&D carried out by industry. Announced nearly five months ago, the suspension of grants was a neat, if none-too-subtle way of coping with the large demand for money from an industry sparking, it seems, with marvellous ideas that it would love to fund, if only it had the money. Another interpretation of the enthusiasm with which industry latched on to this scheme is that many companies see the Support for Innovation programme as yet another way of getting money when times are hard—no matter how good the idea is.

The minister with responsibility for information technology, Geoffrey Pattie, explains that the new-work programme will have a different emphasis. In the past, 80 per cent of the funds went to new projects; the rest went to advisory services, the development of new skills and the encouragement of "best practice". Under the new scheme of things, 70 per cent of the funds will go to new projects. There will be more emphasis, in the shape of a 50 per cent larger share of the cake, on encouraging industry to take up the new technologies.

In the next financial year, the government will spend almost £300 million on the innovation programme. Companies with

projects seeking funds must satisfy the government that, without its support, the project would: not go ahead; would go ahead too slowly to produce benefits; or would go ahead at half cost. These are all good criteria; and they must be followed. But this government, of all governments, should be prepared to add a fourth criterion. It should not fund projects from companies that are sitting on obscene cash surpluses.

Now, the companies are quick to point out that people get the wrong end of the stick when they gaze longingly on those money mountains. It is true that large companies need some money salted away for a rainy day. But the size of some piggy banks, such as that held by GEC, hardly justifies such thrift and lack of adventure. Perhaps some companies expect a rerun of Noah's flood. If people "on welfare" have to declare their savings before they receive help, and if students have to submit to a means test, why not companies that want grants to fund their research?

Small companies rarely have money sitting there doing nothing. They also find it notoriously difficult to win grants. Pattie is trying to help, he says, by minimising the bureaucracy and by placing on them less stringent criteria for eligibility.

Perhaps Pattie and his fellow ministers should look more closely at the cosy relationship that exists between the government and some of Britain's largest companies. One thing they will find is that large areas of research of fundamental importance raise hardly a whisper of interest in the companies that stand to benefit most.

Take the work of the British Geological Survey (see p 10). The survey believes that its work is vital to the long-term health of the country. But it finds that, the companies, the very people who speak longest and loudest about industrial profitability and the need for research to support the economy, offer it little support.

The survey is in an odd position. It claims that its research is "strategic" rather than "basic". This is one reason why it wants a divorce from its present paymaster, the Natural Environment Research Council. But it knows full well that industry will not pick up the bill, and it is fearful of claiming protection from its natural sponsors, the Department of Energy and the Department of the Environment.

You have to sympathise with the survey. It really is torn in all sort of different directions. As such it typifies research in this country. The "basic" side is vilified for caring too little about the needs of industry; the "applied" side finds little support in that same sector. And the government sits in the middle like a referee that has lost his whistle. The survey is right to seek an inquiry into its role in life. That inquiry should involve all of those with an interest in the geological sciences in Britain. A large number of companies must make their views known. They must also be prepared to defend their attitude and explain why they do not support research carried out on their behalf at the government's expense.

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Editor: Michael Kenward
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THIS WEEK

Design failings that caused Bhopal disaster

LAST week, Union Carbide published its account of the disaster that killed more than 2500 people near its pesticide plant at Bhopal in India in December. The accident was "the result of a unique combination of unusual events". The report hints at sabotage. But the data in the company's report do not support this conclusion. They reveal that the accident was the result of faults in the design of the plant's safety system—which was the responsibility of Carbide's headquarters in the US.

The seven engineers and scientists who made up Carbide's investigation team arrived in India on 7 December, four days after methyl isocyanate (MIC) had boiled out of a storage tank. They stayed in India for 24 days, constructing a hypothesis about what went wrong. They finally agreed with Indian scientists. (*New Scientist*, 10 January, p 3) that the MIC was driven out under pressure generated by a runaway polymerisation reaction, which was started by water. Back in the US, Carbide's scientists, adding water, chloroform and iron to MIC, succeeded in recreating in the laboratory the same ratio of reaction products as those remaining in the tank in Bhopal.

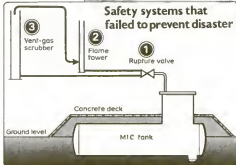
The report makes much of the fact that the last batch of MIC put into the tank before the accident contained more chloroform than product specifications allowed. Chloroform can promote the polymerisation of MIC. It can also corrode the steel tank during the reaction, thus freeing iron as a catalyst.

The team traced the production of MIC containing too much chloroform to distillation during manufacture of a batch of MIC at the plant last October. But this does not mean that chloroform caused the accident. The report says that "the presence of 2000 or more pounds of water would have caused the accident without the chloroform being present". And chloroform alone could not react without the high temperatures caused by the reaction with water. The company's safety chief, Jackson Browning, told a press conference last week the presence of extra chloroform was "one of a series of unusual events" that "led to the incident".

The report says water alone was enough to explain the runaway. The investigators conclude that "all the significant components of the residue could have resulted from recognised, albeit complex, chemical reactions".

A key question is why the factory's safety devices, which should have been designed to cope with a chemical that is known to be subject to violent reactions, did not work.

Debora MacKenzie, Geneva



Three safety devices that proved inadequate. Top: downtown Bhopal

The report implies that they failed due to negligent maintenance by Indian staff. However, the team's own reports of its interviews with plant employees indicate that the equipment did operate.

The MIC tank had three safety devices. A pipe leading from the tank contained a valve which was set to rupture if pressure in the tank exceeded 40 pounds per square inch (psi). Beyond the valve were two further devices. One was a flare tower to burn escaping gas. The other was a vent-gas scrubber, a tower packed with loose material through which a solution of caustic soda could be poured onto rising MIC to decompose it.

The investigation team reports that at 0015 hours on 3 December the operator of the factory's control room noticed that pressure in the MIC tank had risen from 2 psi to 30. Then "in moments" it rose above the gauge maximum of 55 psi. The tank was hot and rumbling, its concrete cladding was cracking, and the safety valve was "screaming".

Carbide's report says that the flare tower, was shut for maintenance. So the operator turned on the vent-gas scrubber.

Carbide says that a flow meter failed to indicate that a flow of caustic soda had started. But that morning, after the accident, the scrubber's runoff solution was hot. This shows, says the company, that the scrubber had worked. Subsequent tests showed that the pump had worked properly. The flow meter started working again once it had been cleaned.

There is other evidence of poor maintenance at the plant. The concentration of the caustic solution had not been checked since October, the report says. But the evidence is that the scrubber probably worked normally on the night of the accident.

The scrubber did not contain the MIC, however. At 0100 hours, when the scrubber had been on for 45 minutes, Carbide says the plant superintendent "verified that MIC from tank 610 was being emitted from the scrubber stack to the atmosphere".

Carbide's report does not comment on the apparent inadequacy of the scrubber, or on why the plant was equipped with only one flare tower, without a backup system to be used during maintenance.

The investigators do address the question of where the water that started the reaction came from. "The exact source of the water is not known, but ... 1000 to 2000 pounds of water would have accounted for the chemistry of the residue. Water could have been introduced inadvertently or deliberately directly into the tank", through any of the pipes leading into it. Press comment on the report has emphasised the suggestion of sabotage.

What the investigation shows is that water alone caused the Bhopal disaster, and the factory could not contain a water-induced runaway reaction. The investigators do not report any evidence that water might have been added deliberately. Nor do they say why anyone should have engaged in sabotage.

The investigators do suggest how the water could have got into the tank inadvertently, however. They report that a valve linking the tank with the atmosphere may have been open a few days before the accident. When nitrogen, which forms a pressurised blanket above the MIC in the tank was pumped into the tank on 30 November and 1 December, the tank "could not be pressurised ... if nitrogen was indeed escaping, the escape route could also have provided a route of entry for water".

Moreover, pipes leading to the tank had been washed with water "shortly before the incident". There was no shield to prevent water entering the tank. If several valves were open, water could have got into the tank, Carbide says. But the company dismisses "this possibility as 'highly improbable'".

The investigators report that the MIC should have been kept at freezing point in the tank. But, because the refrigeration was not working, the temperature in the tank at the time of the accident was 16°C. Refrigeration would have slowed the initial phases of the runaway.

► It is hard to know what good this would have been. Carbide's report says that the scrubber was regularly used to dispose of substandard MIC, which would percolate up the tower as a vapour. In order to have dealt with a runaway reaction, workers would have had to vent the reacting mixture through the scrubber, or the flame tower. Both seem to have been designed to handle only routine escaping gases—not a runaway reaction containing liquids and solids as well as gas. An emergency venting might have worked if the mixture had gone first to a "knock-out pot, where liquids and solids could settle. But there was no such pot in the Bhopal safety system.

Because of this, it seems likely that the

scrubber was overwhelmed. Carbide's team says that liquids and solids as well as gas came boiling out of the tank in Bhopal "due to the foaming of the reaction mass".

Chemical safety engineers, including some from Union Carbide, will report to a meeting in Houston in the US this week that most safety systems in chemical plants are not designed to handle such "multiple-phase" flow.

Now it will be up to courts in New York and India to decide whether some careless worker was to blame for more than 2500 deaths, or whether it is the company, whose safety systems could not contain a known hazard of storing MIC, that bears the responsibility. □

Chemical weapons review

A US Presidential Review Commission on chemical weapons arrives in London at the end of this week to hear evidence from experts and interested parties before making recommendations to Congress on the President's proposed binary weapons programme. The nine-member commission includes former secretaries of state Alexander Haig and Zbigniew Brzezinski.

The review commission was established as a result of recommendations made last April, in the wake of a third defeat for the administrations attempts to win Congressional support for the binary programme. □

Battlelines drawn in the clean-car contest

EUROPEAN ministers decided last week that all cars should emit lower levels of noxious chemicals into the atmosphere by 1994. But they did not decide what those levels should be. Instead they divided cars into three groups, according to their engine capacity, and set up a technical committee to recommend emission levels for cars in the top two categories. Ministers will meet again on 25 June to consider those recommendations.

Although the technical discussions will go ahead, the ministers' decisions cannot be formally adopted by Europe until Denmark lift its reservation. Tomorrow (Friday), the Danish parliament may decide to drop its objection that the timetable is too slow.

The chemicals in a car's exhaust fumes that concern ministers are oxides of nitrogen (NO_x), hydrocarbons (HC) and carbon monoxide (CO). The first two may be critical in the formation of acid rain.

There are two technologies to combat noxious emissions: the lean-burn engine, which is most effective for cars with a small engine-capacity, and three-way catalytic converters. The catalytic converter is already in use in Japan and the US, which already have far tougher standards for emissions of noxious chemicals than Europe. The lean-burn engine is at an earlier stage of development.

Britain's junior environment minister, William Waldegrave, argued meeting for a delay in the introduction of new emission standards while car manufacturers develop lean-burn engines. Japanese cars are already designed with the converters, so Europe's car manufacturers could otherwise suffer. West Germany, with its concern about acid rain, wanted emission standards comparable with those in the US to be introduced by 1988-89. In the event, there was a compromise. Britain accepted that new models of cars with an engine capacity greater than 2000 cc should meet new emission standards by 1988, and all new cars with this engine size should meet the standards by 1989. This means they will need catalytic converters.

The ministers agreed intermediate levels for emissions from cars with an engine



Waldegrave, and the catalyst he opposes

capacity less than 1400 cc. By 1990, new models in this category must emit no more than 45 grams of carbon monoxide in a standard test, 15 grams of HC and NO, combined, and 6 grams of NO_x alone. More stringent levels for these cars will be set in 1987 for implementation by 1993 for new models and a year later for new cars.

The main area of controversy concerned the cars with engine capacities between 1400 cc and 2000 cc—the largest sector of the European car market. Manufacturers do not want to have to tool up production lines to fit catalytic converters when they may soon be able to reduce emission with a new design of engine, combined with a leaner mix of fuel and air. The chemically ideal mixture of air to fuel for combustion

is around 15:1. At this ratio, the flame is at its hottest. But this also maximises production of oxides of nitrogen. More air in the mix reduces temperature, and therefore pollution. A lean-burn engine is driven by an air-fuel ratio between 18:1 and 22:1.

The problem is that at these ratios, the fuel droplets are thinly and unevenly dispersed, and the flame in the compression chamber can go out. Manufacturers get around this by creating turbulence to improve the homogeneity of the mix. This uses up fuel, so, to reduce this, manufacturers are using computers to design components that create turbulence when the air-fuel mixture flows over or through them.

Ford will launch a lean-burn engine working an air-fuel ratio of 18:1 by the end of this year. The Japanese company Toyota already has a car on the market which works at a ratio of 22:1.

The case for lean-burn technology is strong. Its advocates point to the greater fuel efficiency of the lean-fuel-air mix compared with cars fitted with catalytic converters. They add that lean-burn engines are cheaper and do not depend on any particular type of fuel, whereas catalytic converters need lead-free petrol.

But these arguments have their flaws. To meet emission standards that are as rigorous as those in Japan and the US, lean-burn engines will need to be fitted with oxidation catalysts. These oxidise hydrocarbons so that they cannot take part in the chain of reactions leading to acid rain. Although these catalysts are simpler than three-way catalytic converters, they still need lead-free petrol to work effectively.

Three-way converters are also much more effective at cutting oxides of nitrogen. Today's lean-burn engines reduce NO_x by between 75 and 90 per cent. A three-way converter can eliminate between 90 and 95 per cent. European driving conditions could reduce the effectiveness of catalytic converters. The fuel-air mix must be at a certain temperature to activate the NO_x part of the catalyst. Tests of driving in Paris suggest that the constant stopping and starting on European roads might mean this temperature not being met.

Gas victims arrive in London

LAST Thursday, eight Iranian soldiers suffering from the effects of chemical weapons were flown into London for treatment at the St John and St Elizabeth hospital. One, Gholam Hosain, died on Monday night. This is the first time since last April that Iraq has used poison gas in its war with Iran. Last year, eight Iranians were treated in London's Cromwell and Princess Grace hospitals (*New Scientist*, 22 March 1984, p 4).

Once again the main chemical involved seems to be mustard gas, although reports from Iran suggest that the nerve gas tabun has also been used, as well as an unidentified chemical which may be hydrogen cyanide.

The gas attacks began on 13 March, during fierce fighting around the southern town of Basra and near the Majnoon islands. The new gas was reportedly used on 15 March in the Majnoon area and preliminary analyses suggest that the compound is based on cyanide. Gas masks apparently proved ineffective and those in direct contact with the gas cloud died almost immediately. Others suffered temporary disturbances of vision and headaches.

Hydrogen cyanide was used in the First World War, but was not considered a very efficient weapon. Being heavier than air, it tended to stay near the ground. Its ability to penetrate masks, however, gives it a possible role as an auxiliary gas intended to cause troops to remove their masks so that other gases can have greater effect.

In an advertisement in *The Guardian* last week, the Iranian Embassy in London invited enquiries "from all those familiar with these substances and experienced in treating injuries of this nature, or those doctors prepared to treat the victims of chemical warfare on a humanitarian basis



A victim of the latest chemical conflict

in this country or in Iran".

Iraq would appear to have established chemical weapons as a regular part of its arsenal. Kurdish guerrillas in northern Iraq are convinced that the gases will soon be used against them as well. During an attack on an Iraqi Army base at Shadala in February, guerrillas of the Patriotic Union of Kurdistan found stocks of gas masks. A PUK spokesman said this "raises the alarming question of the possibility of the use of poison gas by the Iraqi government against the people of Iraqi Kurdistan". □

Other people's smoke

AROUND 1000 non-smokers die each year in Britain from the effects of tobacco smoke, according to research by the Addiction Research Unit at the Institute of Psychiatry in London.

The study will be published shortly. It shows that non-smokers, including children whose parents smoke, have measurable levels of nicotine and its metabolite cotinine in their bodies. The concentrations average between 0.5 per cent and 1 per cent of the levels typically found in smokers.

Some 100 000 smokers are believed to die from the effects of their habit in Britain each year. Dr Michael Russel, the head of the addiction unit, says: "If you assume... that the risk is between 0.5 per cent and 1 per cent of the risks to smokers of smoking... then around 1000 non-smokers will die of smoke-related diseases."

Other recent studies have shown that sidestream smoke, inhaled by people near smokers, is more noxious than that inhaled directly by the smokers. Levels of nicotine and carbon monoxide are twice as high in sidestream smoke and carcinogenic nitrosamines are 10 times higher. □

Ozone deal is paper-thin

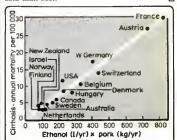
FORTY-NINE countries agreed last week on a convention to protect the ozone layer from destruction by chlorine contained in chlorofluorocarbons (CFCs), which are widely used in aerosols and refrigerants. But the nations could not agree on how to do it.

One group, including the US and Scandinavia, wants limits on aerosols alone. Another, including the EEC nations, wants a ceiling on all production, including CFCs used in refrigerants. Japan objects to both ideas, and many Third World nations fear that a ceiling on all production could prevent them developing more refrigeration plants, which are vital in the Tropics.

Since 1976, production of CFCs for aerosols has halved, while other uses has shot up by 36 per cent. Nobody knows how much CFCs the USSR produces. The convention did agree to carry out more research. Scientists will meet again next year. After that, the diplomats will try again to reach agreement on action. They hope to sign a protocol in 1987. □

Beer and sausages

PORK may be a missing ingredient in the cause of cirrhosis of the liver. Scientists in Canada have discovered that the consumption of pork in 16 countries examined correlates strongly with the incidence of the disease. When pork consumption is combined with the consumption of alcohol (as shown in the graph below) the link becomes overwhelming. The change of the correlation in the graph occurring by chance is around a thousand to one. The results are published in the current issue of *The Lancet*. The authors say: "How pork might cause or enhance cirrhosis is unknown... but pork contains more linoleic acid than beef." □



MPs investigate Sellafield clean-up

THE NUCLEAR industry's plans for reducing the radioactivity of discharges to the sea from Sellafield were under scrutiny by MPs this week. The House of Commons Environment Committee spent two days in Cumbria quizzing British Nuclear Fuel's (BNF) management as part of its six-month review of radioactive waste management.

The trip coincided with technical sessions of the Paris Commission in Hamburg. The international commission is assessing Britain's plans to minimise radioactive discharges into the marine environment taking account of "best available technology".

According to evidence submitted by the environmental group Greenpeace, liquid emissions into the sea from Sellafield could be cut to zero. The group wants all spent fuel elements from power stations put into dry storage, rather than in cooling ponds. It also wants all waste from reprocessing of spent fuel to be decontaminated by evaporation rather than the chemical methods used at present. And it wants the resulting sludges to be solidified and stored on the Sellafield site. Greenpeace claims these facilities could be ready by 1988. It does not say how much it might all cost.

Within the next three months, BNF will

begin using the first stage of its own new strategy for cutting radioactive discharges into the Irish Sea when its Site Ion Exchange Plant (SIXEP), costing £126 million, opens. SIXEP uses the naturally occurring zeolite Clinoptilolite, an aluminosilicate mined in California, to absorb radioactive caesium and strontium in the reprocessing effluent.

In the longer term, discharges will be reduced by the construction of an additional effluent treatment plant to remove alpha activity and to treat stored liquids for the removal of both alpha and beta activity.

The Radioactive Waste Management Advisory Committee, which advises the government, is now satisfied that, in principle, these measures will meet its requirements. These are that discharges should ensure that the dose to the most exposed group (local eaters of shellfish) will be less than 10 per cent of the limit recommended internationally.

By 1991, BNF expects to cut total liquid discharges tenfold. But MPs will be sceptical of BNF's timetable. SIXEP is two years behind schedule. And delay is also likely for plans to get approval for a complex to handle the radioactive sludge left after the ion-exchange process. □

Veteran wins compensation for radiation injuries

Steve Connor

A VETERAN of the British atomic bomb tests in the 1950s will receive compensation from the government because of injuries that he might have received by exposure to radiation. It is the first case of its kind, and will help other atomic veterans who are making similar claims against the government.

Mick Saffery, who spent about 10 months on Christmas Island as a corporal during the "Grapple" series of tests in the late 1950s, has won his claim that the cataracts in both of his eyes could have been the result of exposure to radiation. The British government still maintains that no-one received dangerous levels of radiation as a result of the tests. Even so, the judgement of the Pensions Appeal Tribunals of England and Wales means that the Department of Health and Social Security (DHSS) now has to pay compensation to Saffery because of his injuries.

Saffery, who now lives in the US, will have his eyes tested this week by doctors who will report back to the DHSS in London. Following this examination, the department will assess how much it will pay Saffery for his disability. A spokesman for the DHSS said that Saffery's case does not have any particular implication for anyone else because each claim is being looked at on an individual basis. However, lawyers acting for other veterans are bound to see Saffery's case as a precedent, which will make their clients' cases stronger.

In 1981, the government rejected Saffery's claim for compensation, which he had made after two eye operations in the US. However, in February 1983 he lodged an appeal with the Pensions Appeal Tribunals, a court which has medical experts to help make judgements. The tribunal reached its decision in July 1984. It ruled that Saffery's injury (bilateral cataracts) "is attributable to service".

In addition to cataracts, Saffery also

found that he had a very low sperm count, which is also consistent with his having been exposed to radiation. In its judgement, the tribunal said: "Even discounting these two pieces of evidence, which are merely straws in the wind, we feel that... we are left unsure that the cataracts were not caused by Christmas Island radiation. It follows from this that the appeal must be allowed on the basis that the disability is attributable to service."

In effect, the tribunal found that it was the duty of the British government to prove that Saffery had not been exposed to radiation in the course of his duties on Christmas Island. It was not Saffery's responsibility to show that he had been

exposed to radiation.

"I was very, very surprised when I heard that I won the case," Saffery said last week. After the government had rejected his claim, he thought it was not worth pursuing an appeal, until his mother, who lives in Birmingham, read press reports about the controversy over safety precautions during the tests.

Saffery was not on Christmas Island when the bombs were exploded, but he was there afterwards. He thinks that he was exposed to residual radiation when he showered in sea water, or when he played football and grazed his legs on the pitch, made of crushed coral.

The DHSS said that it disagrees with the tribunal's judgement and will fight any similar cases that appear. □

Bright lights in a dull landscape

THE MEDICAL Research Council's Laboratory of Molecular Biology is far and away Britain's most productive centre for protein crystallography, according to a study of the discipline published today. The laboratory produced 42 per cent of all British papers on the subject between 1975 and 1982. The papers from the laboratory accounted for 60 per cent of the total of British papers cited over the period. None of this stopped Britain's impact on the discipline worldwide from declining over the same period.

These facts are reported in a pioneering study of two research disciplines, conducted by looking at the quality and quantity of published papers*. The Advisory Board for Research Councils (ABRC) commissioned the study from Ben Martin, John Irvine and David Crouch, of the Science Policy Research Unit at the University of Sussex. The idea was to try out the method as a measure of the fruits of scientific research. The first two disciplines analysed were protein crystallography and ocean

currents. Three more will follow.

The investigators found that research into ocean currents in Britain is dominated by two centres, the Department of Pure Mathematics and Theoretical Physics at Cambridge University, and the Natural Environment Research Council's Institute of Oceanographic Studies, whose main centre is at Wormley in Surrey. They also discovered that remote-sensing observations from satellites are described in 7 per cent of papers on ocean currents, usually in combination with observations from ships.

The studies each cost about £4000. The researchers conclude that such studies can reveal a large amount of useful information about the state of a research discipline. But they add that the results of such a study could be better interpreted if more was known about the "inputs", such as the numbers of people involved and the amount spent on equipment. □

* Science Indicators for Research Policy: A bibliometric analysis of ocean currents and protein crystallography, SPRU Occasional Paper No 23.

El Niño blamed for Galápagos fire

FIVE hundred giant tortoises are to be airlifted to safety from their home on the Galápagos island where they are threatened by a bush fire that was started by local farmers. But the airlift cannot save another threatened species, a sunflower tree found nowhere else in the world.

The fire is one more on the list of disasters wreaked on eastern South America by the 1982 anomaly in ocean currents, known as El Niño. The excessive rains that year caused a luxuriant growth of vegetation, which has now dried out. When farmers on Isabella island, the largest in the group, burnt their harvest stubble this month, the fire swiftly ran out of control. This week another fire started on San Cristóbal island.

The first fire now covers 25 000 hectares and is spreading up the slopes of the Sierra Negra volcano, towards the village of Santo Tomás, Ecuador, which owns the islands, is



Farmers fight the fire (their stubble burning started it).

trying to get money to pay for water-bombing planes to stop the fire. The World Wildlife Fund is trying to come up with the \$100 000 needed to airlift the tortoises before the fire reaches them.

Ecuador may also have other problems

on its hands—last week, seismic readings warned that one of the island's volcanoes may be about to erupt.

Peter Cramer of the World Wildlife Fund and a former director of the Charles Darwin Institute on the Galápagos, says neither fire nor eruption is normally much of a threat to the Galápagos' unique animals. The islands on which they evolved are regularly swept by both.

The problem, he says, is that their numbers have been reduced, mostly by competition with rats, cats, goats, dogs and pigs introduced by humans. Hence, a population that might ordinarily withstand a fire could be already so stressed that

"normal" events like this become too much for it. There are only 400-500 of the threatened Sierra Negra subspecies of tortoise left. The nearest penguins, however, are safe, the other side of 30 barren kilometres of lava. □

How blood traders could have launched AIDS

HOW DID the AIDS virus infect the first Westerners to suffer from the disease? Up to now, epidemiologists have assumed that it has infected the homosexual community in the US by sexual contact with people who have visited Haiti or Central Africa, where acquired immune deficiency syndrome (AIDS) seems to be endemic.

However, a new theory has emerged this week, suggesting that the AIDS virus has contaminated the world's supply of blood plasma by the illicit activities of international blood brokers. These brokers, so the theory goes, bought cheap plasma from countries in Central Africa and the Caribbean and sold it at a high price to American firms that process the plasma to isolate blood products such as Factor VIII.

Once the virus had been introduced in this way it quickly spread in a population "with no natural resistance to the virus and with a proclivity for promiscuity", says Dr Peter Jones of the Newcastle Haemophilia Centre in a letter in the current issue of the *British Medical Journal*. He warns that if the blood trade is still going on "plans for

[blood] screening are clearly inappropriate. The heat treatment of factors VIII and IX may remove the risk of AIDS transmission, but other blood products, notably intravenous gammaglobulin from multiple donations, must still be considered as potentially infectious until individual donor testing can be performed."

"If the theory is correct," says Dr Kenneth Castro from the US's Centers for Disease Control, which first diagnosed the disease, "then how come it is so prevalent in gay men as opposed to haemophiliacs?" He says that Jones's suggestion is difficult to reconcile with the fact that AIDS was found in American haemophiliacs about a year after it was found in homosexuals.

Nevertheless, the virus could have been introduced simultaneously into the US by contaminated blood plasma and sexual transmission. Once it had infected promiscuous homosexuals it quickly became an epidemic as their life styles acted as an "amplifier" for the virus to spread.

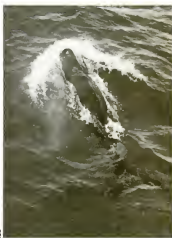
During the 1970s, the international trade in blood plasma was relatively free of restrictions. Centres for plasmaphoresis

(the separation of plasma from blood cells) operated in a number of Third World countries in Africa and the Caribbean. At these centres, plasma containing the valuable proteins would be separated from the red blood cells, which was then returned to the donor.

Bob Riley, from the American Blood Resources Association, said that every source of blood plasma now has to be licensed, and there is only one outside the US—a plasmaphoresis centre in Belize.

His assurances, however, cannot explain the statement of a Californian blood broker, Hermann Plaut, who, on West German TV last year, said that blood brokers operate everywhere in the world and buy and sell blood plasma by telex. □

Japan halts whalers



JAPANESE fleets have withdrawn from whaling in the Southern hemisphere, according to the latest information received by the International Whaling Commission (IWC) outside Cambridge. The Japanese stopped hunting after they and the Soviet Union's fleet had caught 4224 minke whales. This is equal to the quota for minke whales set at last year's IWC meeting in Buenos Aires. The figure was later objected to by Japan, the Soviet Union and Brazil.

The Brazilians have yet to start their minke whaling this season. Although the USSR had not declared a halt, it had not caught any more minke whales after the Japanese stopped. The Japanese originally said that they would ignore the quota and aim for the previous year's figure of 6655.

In the continuing legal battle in the American courts over an agreement between Japan and the United States to allow continued whaling until 1988, the US Commerce Department has obtained a stay of judgement pending appeal. Conservationists had claimed a victory when Judge Charles Richey decided two weeks ago that the government was bound by law to apply sanctions. This decision has now gone forward to the Appeal Court, where it will probably be heard in May. □

Third-World kidneys for sale

BLOOD is not the only element of the human body that is attracting an international trade. Doctors and kidney patients throughout West Germany received sales brochures last month from Doctor Hajo Harms of Aachen, offering them kidneys taken from live donors in the Third World. The kidneys were to be bought for DM100 000, about £28 000.

Harms made a detailed sales pitch. Some 2000 kidneys are needed for transplants each year in West Germany. Transplant centres receive only 1200 a year from the victims of road accidents and the like. Harms will provide the rest. "As for the DM100 000 poor Brazilians or Indians will get in exchange for their kidney, it will let them live comfortably till the end of their days," say his brochures. German doctors were quick to respond. Karsten Villmar, the president of the German Medical Association, said: "The man is not right in the head." Herbert Klosterhalfen, the head of the kidney transplant clinic in Hamburg, said: "This is an abominable attempt at commercialisation."

Harms appeared unperturbed by the fuss. At a press conference, he announced that he wanted only to publicise Germany's severe organ shortage. "If only one person in 100 000 declared that they would donate organs now or after death, German medicine would have three times as many organs as it needs," he said. "Moreover, that would put an end to the shameful, neocolonialist business in organs which is beginning to develop in the Third World."

Not everyone believes him. It was "a bad attempt to get out of a difficult situation," says Eckehard Renner, the head of the association of German transplant centres. To support his story,

Harms says he sent notices to doctors but not to any prospective donors, registered his "organ brokerage" with a capital of only DM10, and, as a final touch, showed the assembled press his own organ donor's card.

Serious or not, Harms has touched a nerve in Western medicine. In West Germany alone, there are 2550 new chronic kidney patients each year, and 3550 are now waiting for a suitable kidney. Some will die during an average wait of two years.

So far, the medical profession has put tight controls on the organ business. One reason is immunological: the chances of a good match with a non-relative are slim enough that "we simply don't transplant kidneys from living unrelated donors," says Kurt Dreikorn of the Heidelberg transplant clinic. Professional associations expel doctors who transplant organs obtained commercially.

This does not stop some doctors from trying. Last spring, a doctor in Chicago offered West German patients immediate transplants for DM70 000. This is 50 per cent more than the operation costs in Germany. Doctors will not say if any patients took up the offer.

But some doctors wonder if a commercial solution to the shortage of organs may not be needed. Horst Wilms of Freiburg University says that, apart from the medical problems, Harms' idea "may not be so crazy", although West German doctors look to Germany's annual 40 000 deaths in accidents as a more likely source than the slums of Rio. The Harms affair has at least shown that there is no law against it. Attempts to shut his "business" failed for lack of any law prohibiting organ trafficking.

Debora MacKenzie, Geneva

School science for all—but who pays?

Marcus Chown

THE GOVERNMENT has committed itself to ensuring "science for all" in schools for everyone from 5 to 16 years old. But a subtle change of wording in its new policy document will revive fears that there will be no money to pay for extra teaching.

In 1982, the Department of Education and Science published a consultative document called *Science Education in Schools*. This document said that the scheme would require "an increase of between 10 and 20 per cent in the present number of science teachers". The statement is dropped from the new report published last week which, instead, claims: "Because secondary pupil numbers will be falling sharply over the next few years, the constraints of teacher supply need not prevent such a shift, provided that there is a willingness to plan for it."

Ministers' own advisers disagree with this assertion. Dick West, the director of the government's Secondary Science Curriculum Review, says that there will not be enough teachers or equipment to implement the new policy. The fall in school rolls is, in any case, a temporary phenomenon. It has ceased in primary schools already. Richard Turner, of the Association for Science Education, said: "The document provides no practical suggestions for the implementation of science for all."

At the heart of the new policy is the aim of ensuring that all 15- and 16-year-olds are exposed to science for one-fifth of their school week. This means more science for all except those studying for three science O-levels.

The policy statement says: "Each of us needs to be able to bring a scientific approach to bear on the practical, social,



Mr Stinks: Fewer facts and more insight are required

economic and political issues of modern life." It says that science can foster a range of desirable qualities, including curiosity, healthy scepticism and the ability to evaluate evidence critically.

Too few pupils are introduced to science in any systematic way at primary school, says the government. Many teachers at this level have no working knowledge of elementary science. As a first step, the document suggests the use of teachers who do possess a science background as science consultants to provide help and advice to colleagues. Ultimately, in-service training for teachers must make good the deficiency, it says. All class teachers in primary schools, should include science in their teaching.

The document calls for individual records on each pupil to be kept on their attainment in science.

Science teaching in the first three years of secondary school, with its emphasis on

providing a broad grounding in science, needs little reorganisation. But the document calls for a "radical reappraisal of current provision in years four and five". Pupils who now drop science at this stage will carry on, many of them through classes in integrated science.

Perhaps the most radical suggestion of the document is that "the factual and theoretical content of many existing courses will need to be sharply pruned". This, says the document, should help practical understanding of science. It should, however, be done without reducing the intellectual demands and rigour with which science is taught. The government is putting its trust in the Secondary Science Curriculum Review to develop and test courses which satisfy this criterion.

● The past 15 years has seen a dramatic increase in the number of children passing O-levels in science subjects. Recent statistics from the Department of Education and Science for the period 1971-1983 show that the proportion of children attaining grade C or above in physics or chemistry has leapt by more than 50 per cent. More startling still is the increase in the percentage of girls passing chemistry and physics. Girls making the grade have risen by 110 per cent, almost three times that chalked up by boys. The DES's statistics reveal a significant switch of girls from biological sciences (a traditional preserve) to physical sciences.

The National Union of Teachers says that the improving examination results have accompanied the transition from grammar and secondary modern schools to comprehensive schools. □

* Science 5-16: A statement of policy. HMSO, £1.50.

Industrialists will help to allocate university cash

THE DEPARTMENT of Education and Science (DES) has come up with an extra £68 million over three years for training in engineering and technology, particularly information technology.

The announcement formed part of the Budget, unveiled by the Chancellor of the Exchequer last week. Higher education will receive £43 million over three years to train 4000 extra graduates in engineering and technology. Most of the new places will be in information technology.

For the first time, industrialists have been explicitly asked to become involved in allocating the extra money to the 20 institutions, all universities, that will benefit from the £11 million to be allocated in the first year. Companies will be expected to return the favour by providing support for the new places in the form of equipment, scholarships for students, and senior employees seconded to teach.

The other £25 million will go on a two-year programme of in-service training for schoolteachers. The money will be allo-

cated through the Manpower Services Commission, since the DES does not apparently trust local authorities to spend it on the specified objectives.

The new places in higher education come in response to complaints from industry that there are not enough graduates with the skills needed by industry. This view was repeated in a recent report by the Department of Trade and Industry's IT Skill Shortage Committee. The committee estimated a shortfall of 1500 IT graduates in 1984 and predicted that this would have grown to 5000 by 1988 (*New Scientist*, 2 August 1984, p 5). Other schemes already provide for another 6000 places in the next few years.

The novel element in the new scheme is industry's direct involvement in selecting from the "bids" submitted by the various universities. Industry's collective voice will be represented by the Information Technology Skills Agency (ITSA), part of the Education Foundation of the Confederation of British Industry.

Sir Robert Clayton, technical director of the industrial giant GEC until he retired in 1983, will chair ITSA. Clayton is also currently a member of the University Grants Committee.

A team of industrialists under Clayton has already advised the UGC on how to allocate the money. About a quarter of the funds come from the UGC's own budget; the rest is mainly from the Department of Trade and Industry and the Department of Employment. Details of the first year's allocations will be announced early in April. Next year's money may be spread beyond universities, for example to the Cranfield Institute of Technology, a proposed new institute at Salford, the Open University and the polytechnics.

On Budget day, the Prime Minister invited 30 selected industrialists to a meeting to be held in the next few weeks, where they will be asked to specify what kind of backing they are prepared to provide for the new places. □

Broads breakthrough in conservation funding

CONSERVATIONISTS are heralding a watershed in the protection from the plough of traditional grazing marshes. From next week, the government will offer compensation to farmers on Halvergate marshes, part of the Norfolk Broads, who agree not to drain and plough their marshes. The announcement came only days after Britain won approval from the EEC's agriculture ministers to allow national governments to subsidise traditional farming in designated "environmentally sensitive areas".

Conservationists now hope that there has been a profound change of heart within Britain's Ministry of Agriculture, Fisheries and Food (MAFF) that will eventually afford protection to other threatened wetlands.

In recent years, the Halvergate marshes have become a *cause célèbre* among those trying to protect traditional farming landscapes. The 4500-hectare marshland in the heart of the Norfolk Broads is one of the largest surviving wetlands in Britain. As conservationists raged about public money being spent to subsidise draining and ploughing in the marsh, the destruction continued. Broadland Friends of the Earth estimates that 350 hectares were ploughed up last year alone.

But, under an experimental scheme announced earlier this month, Halvergate's farmers will now receive payments of up to £120 per hectare if they stick to traditional low-intensity grazing. The scheme has a budget of £1.7 million and will last three years. Half the money comes from MAFF and the other half from the Countryside Commission, a government body charged with conserving the countryside.

To qualify for the cash, farmers must agree to forego the plough; to keep grazing down to agreed levels (roughly 2 cows or 15 sheep per hectare); to cut hay or silage only once a year; and use only simple herbicides. The first payments will be made in October.

The amount of money set aside is enough to preserve most of the marsh. The success of the scheme will depend, therefore, on its uptake by the 150 landowners on Halvergate.

The scheme is the first subsidy by MAFF to favour conservation over agricultural "improvement". It follows last year's refusal by MAFF to subsidise drainage and arable conversion in Derwent Ings, the wetland in South Yorkshire at the head of the Humber estuary. And it is an obvious precedent for other threatened wetlands, such as the salt-marshes around the Wash and the Somerset Levels.

At a press conference in Brussels a few days before the Halvergate announcement, Britain's agriculture minister, Michael Jopling, announced that the EEC will, for the first time, authorise national governments to support traditional farming practice in designated "environmentally sensitive areas". The government promises a bill to

Chris Chippindale

put the new policy into effect in Britain "as soon as possible".

Previously, this kind of scheme has been banned under EEC law. It was seen as interfering with the free competition that is the EEC's *raison d'être*. Conservation has no formal place in the Treaty of Rome.

Action on many other environmental issues has had to be engineered using legislation design to break down barriers to trade. Regional aid has been another device, which the Dutch, for instance, employed to provide subsidies to preserve many of their wetlands from being drained.

But MAFF has fought hard for conventional farming interests. So its abrupt change of heart towards conservation in recent months has been a surprise. Some observers explain it by pointing to the unpopularity in the Tory shires of stubble-burning, hedge-removal and prairie agriculture. Other seasoned

"MAFFia-watchers" are more cynical. As one put it: "I would be very surprised if funding for conservation went beyond the absolute minimum required to satisfy political pressure".

Support for the gloomy view came from the first announcement that official environmentally sensitive areas would be restricted to a maximum of just 2 per cent of the country. But since then, MAFF has had second thoughts, and now says there will be no limit. In fact, the entire country could be designated.

There are changes in timing, too. The enabling bill will not be introduced before next winter. Legislation is unlikely to come into effect until 1987. The deciding factor on whether the scheme will protect more than a few handsome patches of tourist areas will be the money that MAFF allocates. The Treasury has already indicated that funding for another one-off scheme such as Halvergate will not be found.

The signs are that the annual sum made

available for protecting environmentally sensitive areas will be measured in millions rather than tens of millions of pounds. At the Halvergate valuation of £120 a hectare, a budget of say £5 million would protect just nine areas of Halvergate's size. There seems little chance of conservation being extended from the wetlands to marginal

upland farms, which are also in danger of conservation both to arable farming and forestry.

Professor Norman Moore, of the Farming and Wildlife Advisory Group, says the initiatives over Halvergate and in Brussels remain "very important indeed". A realisation of the effects of habitat loss, which has been "desperately obvious for years", is now starting to affect policy, he says.



Halvergate: conservationists are no longer tilting at windmills

Creag Meagaidh saved from foresters

THE NATURE Conservancy Council has bought Creag Meagaidh, a spectacular Site of Special Scientific Interest in the Scottish Highlands. The deal saves the mountainside from being planted with trees (*New Scientist*, 1 December 1983, p 644).

The council has bought the 3940 hectares of Creag Meagaidh (pronounced Craig Maggie) for £430 000. This is £130 000 more than the land cost its previous owner, Fountain Forestry, two years ago. The site is now secure forever as a national nature reserve. Its purchase is another sign of the high price which public bodies are prepared, under certain circumstances, to put on conservation. The government has given the conservancy council enough money next year to pay for 16 more Creag Meagaidhs.

Conservationists have fears about the consequences of this change of direction. When the site came on the market last time, many forestry management companies steered clear. The site clearly had great scientific and environmental interest and they assumed that, ultimately, planting would never be allowed.

But Fountain Forestry recognised the investment potential. And, without a tree being planted, it has paid off. Now other forestry companies may consider following its lead.

Fountain Forestry has also bought large expanse of unsplotted peat moorland in Caithness and Sutherland. Other companies have ruled the area out because trees do not grow well there, transport is expensive and the landscape is highly regarded.

Stephen Mills

British geology hits rock bottom

Earth scientists are angry that support for strategic work by the British Geological Survey, central to Britain's economic performance, has fallen to such an extent that the country's economic wellbeing is now in danger

Richard Fifield

B RITAIN's geological survey celebrates its 150th anniversary this year. However, this forerunner of such surveys worldwide is now in crisis. Like many research institutes, it is being buffeted by political and financial storms. The heart of the problem is that the British Geological Survey (BGS), as it is now called, is locked into the Natural Environment Research Council (NERC). And, as Digby McLaren, a former president of the Geological Society of America, puts it, the survey is victim of a "bizarre system of management, an irregular budgetary system, and irrational personnel and accounting procedures".

Malcolm Brown, the present director of BGS, explains the financial plight of the survey: "We have met the objectives on staff and finance cut-backs that NERC set us, but when we have paid salaries we can meet operating costs only at the expense of not buying or replacing equipment, instruments and vehicles that are vital to our work." The effect is to close down many survey activities.

The original remit of the Geological Survey of Great Britain, when it was set up in 1835, was to survey the geology of the British Isles in relation to its application to the nation's development of natural resources "and public works". The survey was given statutory powers of access to land and data. It was instructed to interpret and to disseminate the information it gained, and to use it in advising various organisations. The survey was to produce geological maps and memoirs (regional handbooks of geology), published "to a one-inch to one-mile scale to give complete cover according to the state of knowledge".

Now the primary aim of the survey is to acquire and to update knowledge of the three-dimensional geology of Britain. It is concerned with providing accurate large-scale maps (1:10 000 or 6 inches to the mile) and with building up a database on the country's rocks, minerals and surface deposits. The updating is necessary to cope not only with geological changes, such as landslides, changing water courses and fault movements, but also changes in land use and major movements in population.

The maps, memoirs and databases are the starting point for all the applied geology that is concerned directly with the creation of wealth and the avoidance of its loss. The value of the science is in the discovery and assessment of new reserves of raw materials, such as coal, oil, gas, sands, gravels and china clay. Oil revenues from the North Sea amounted to about £16 billion in 1984.

Less familiar, but no less important, is the geologist's role in waste disposal, the management of water resources, tunnelling, foundation engineering, alternative energy, and avoiding the worst effects of earthquakes and volcanoes.

Groups of geologists working in BGS, in

should also be published soon. This group is considering both BGS and the wider support of geology and its research in universities, polytechnics and elsewhere.

Among geologists, a consensus is emerging: there should be a major review of NERC's responsibilities in the geological sciences. The geologists consider as unsatisfactory the present arrangement whereby BGS is responsible to a research council that is mainly concerned with basic research. And why, they ask, should BGS receive its funds through NERC, which gets its money from the Advisory Board for Research Councils, which receives its funds from the Department of Education and Science, which, in turn, has to deal with the Treasury? The geologists are adamant that government and the civil service can devise a better way of overseeing what has always been considered to be "in the nation's interest".

Such views echo statements made in recent weeks by two former members of NERC's council. Professor John Dewey, head of geology at Durham University, resigned from the council in protest against its corporate plan to channel funds away from institutes such as BGS into the universities, and to change the way in which NERC controls its institutes.

Professor John Sutton, of Imperial College, London, wants a public inquiry into NERC. At the opening ceremony of the joint exhibition to celebrate the 150th anniversaries of the BGS and the Edinburgh Geological Society, Sutton commented: "The Geological Survey is the largest of the organisations for which NERC is responsible. It is so large, in fact, that they are the same order of magnitude and no administrative structure really should have that sort of situation."

Many geologists, including the survey's own director, would like to see BGS given the same kind of status as the Meteorological Office or the Natural History Museum in London—independent of the research councils and directly responsible to the minister for science within the Department of Education and Science. In most countries, the geological survey is the responsibility of a minister concerned with mines, minerals and other aspects of natural geology. This is so in the United States, Canada, West Germany, Australia and The Netherlands, for instance. In the USSR and China there are separate ministries of geology. In all instances, the line of control and supply of funds is far less tortuous than in Britain.

Sutton claims that the present crisis arises largely through "misconceptions of



Geological surveys are increasingly becoming databases for 3-D interpretations of deep structures, such as seismic profiles provide (top). The nature of geological research is no longer just with hammer and hand lens but requires sophisticated geophysical and geochemical equipment

universities and polytechnics, and in industry are at present holding meetings to consider how best the British Geological Survey could work and be reorganised. A working group at BGS itself hopes to present the director with its views on 1 April. The advice of another group, coordinated by the Institution of Geologists,

the objectives for which the government set up NERC". Sir Burke Trend's report, which largely established the present structure of Britain's research councils, saw BGS within a Natural Resources Research Council. University research in geology, the report suggested, should be funded by the then Science Research Council.

Dewey deplores the fact that petroleum companies are having to develop exploration programmes in many offshore areas of Britain "aided by Victorian geological maps". The systematic survey work on land and in the shelf around Britain, primarily the responsibility of the BGS, has virtually come to a halt. And BGS's programme for updating its large-scale maps is falling behind schedule. All this is bound to have serious implications for the economic health of the nation. The root cause is lack of funds. The irony is that it should happen when production of metals, coal and oil makes Britain the seventh richest mineral country. Not even mineral-rich Australia and South Africa produce such mineral wealth.

The problems stem from the mid-1970s. Then, on the recommendations within the Rothschild report, the funding for much of the survey was transferred from NERC to various government departments. This they did through specific commissions. By 1979, 85 per cent of all BGS's activity was effectively controlled by government departments. As those departments' own budgets came under pressure, so they progressively withdrew support from survey work. Today, commissioned research largely comes from the departments of education and science, energy, trade and industry, and the environment, and the overseas development administration at the foreign office. In 1980/81, BGS's income from commissioned research totalled £21.4 million and by 1984/85 it had dropped to £15.6 million. This is and was disastrous over a time when funds from the DES Science Vote increased only from £7.6 million in 1980/81 to £9.6 million in 1984/85.

NERC itself is, of course, under enormous pressure from its paymasters. The state departments are proving fickle in a range of commissioned research for its institutes. And the Advisory Board for Research Councils is set on seeing more of the research budget spent on impoverished university departments and less on institutes run and staffed by the councils themselves. The plan is that NERC should switch funds into the universities to the tune of £11 million rising to £16.5 million by 1990.

This switch of funds creates a special conflict for geologists. They widely appreciate the importance of the universities in their science. The universities are responsible for the basic research that lays the ground work for strategic and applied research. Strategic research, which

in geology is the province of the BGS, provides the foundation for research. Departments of state and industrialists, are concerned with applied research in the earth sciences to further their executive or commercial activities.

In recent years, one of the most successful collaborative schemes has been BIRPS, which is an acronym for the British Institutions Reflection Profiling Syndicate. It is a joint venture between people in universities, BGS and oil companies. It was devised to research the structure of Britain and its environs through seismic profiling. This effectively produces a picture of a slice through the upper components of the Earth's crust. The work so far has been in

the necessary funds the deep-geology land project is in abeyance.

Brown believes that Britain should spend more on finding out about its deep geology. "We ought to be drilling. The Russians are already going to 14 kilometres. The Americans have an active programme, as also do the West Germans and the Canadians. Britain has some 3-kilometre ones. The Witney borehole was a contract job and revealed the deep Oxfordshire coalfield. In Cambridgeshire, shallow drilling has revealed some very interesting metalliferous deposits. In the late 1970s, BGS was receiving £500 000 for contract drilling. Now that has all gone and we have no money for it. We are closing down our

drilling teams. Our deep geology is entirely seismic now, and even this is dependant on commercial seismics. We cannot release the commercial seismics even to our own people working on land survey studies.

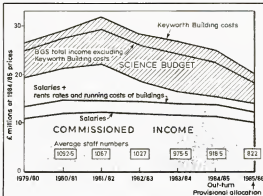
"We need a strategic survey unhindered by the constraints of confidentiality for commercial reasons. Why should we always have to start with the commercial reasons and not for the strategy? No survey should be so constrained. We don't dislike the commissioned research: it has led us into marvellous new avenues, particularly the continental shelf, geothermal energy, and finding ways of disposing of radioactive wastes. Great! But all these avenues are constrained by the customers

making the decisions.

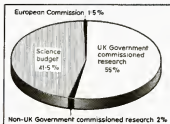
"By the year 2000 we would like to have updated all the geological maps for Britain. Automated cartography for geology is not yet a reality. Developments are leading towards it, and the most tangible one is an automated database. In over 150 years we have accumulated vast amounts of information. Universities and industry cannot use that information to the best advantage if we don't make it accessible in the most readable form. We must make sure that this valuable knowledge resource is not squandered."

There is a need for an independent review of the British Geological Survey, to decide what the nation now wants of it and how best it can be supported. The last major such review was that of the committee under J. L. Wharton, which reported in 1900 on the organisation and staff of the Geological Survey and Museum of Practical Geology. In many countries, the topographic and geological surveys are now one, or very closely related. Brown believes that Britain's various surveys should be brought together. "There is a tremendous commonality of infrastructure, in the hydrographical, soil, ordnance and geological surveys."

Lord Halsbury proposed such a scheme last year when the House of Lords debated the research councils. There is good reason to take this suggestion seriously, claims Brown, "because it would give Britain a strong strategic survey with a much clearer remit".



Financial fate of BGS and its headquarters at Keyworth, Nottingham



The rock cake, 1983/84: how the income came in

the North Atlantic around the Hebrides, down through the Irish Sea, into the Bristol Channel, on to the Atlantic and into the English Channel. One traverse of BIRPS is in the North Sea, between Norway and Britain. The work is throwing much new light on the structure of offshore sediments and rocks, faulting systems and sedimentary basins.

While Britain's offshore efforts present a success story, the study of the deep geology on land has been frustrated by lack of funds. Malcolm Brown claims that being an "imaginative project" it could have gone well. But the Department of Energy pulled out its 5 per cent funding of the consortium, and turned it to on-shore prospecting for hydrocarbons. Sadly, Brown adds, "the only people who could do that were in the deep-geology group". Starved of



Is factory farming really cheaper?

Modern farmers keep their animals in strict confinement and under intensive management. Their justification is that these practices result in cheaper food, but the savings are exaggerated and hidden costs undermine the argument

Jim Mason



Peter Adams/Animals Weekly



Chris Cox

FARMING today relies on the intense management of densely packed animals to produce milk, meat and eggs. Unpleasant though the results may be, they are tolerated, and justified, by appeal to cost. If people want cheap food, the argument runs, animals must pay for it on factory farms.

Ruth Harrison first criticised the trend to factory farming on grounds of animal welfare in her book, *Animal Machines* (London: Vincent Stuart, 1964). The ensuing controversy led the British government to appoint a committee to investigate the new methods of raising animals in close quarters. After visiting factory farms and reviewing evidence from farmers, manufacturers, people concerned about animal welfare and others, the Brambell Committee published an 85-page report in December 1965. Among other recommendations, the Brambell Report called for more space and freedom of movement for factory animals and for an end to de-beaking of poultry, routine tail-docking of pigs and other practices normal in intensive management. These recommendations have never been implemented as laws or regulations, however, and conditions for animals in factory farms have, if anything, grown steadily worse in the years since.

Peter Singer, professor of philosophy at Monash University in Melbourne, renewed the criticism of factory methods and extended it to America in his 1975 book, *Animal Liberation*, and several writers in Great Britain and the United States

have elaborated on the inhumanities, inefficiencies and human health hazards associated with the making of modern meat, milk and eggs.

These criticisms have been met with sharp and heated rebukes from the livestock and poultry industries—especially from those sectors that supply the antibiotics, chemicals, drugs and equipment to factory farmers. In essence, they say that because animal productivity is high, there can be no welfare problem on the factory farm. They say further, that their methods are necessary to keep food costs down, that prices of animal products would skyrocket if drugs were restricted and if animals were given more space. Both claims are, I believe, untrue.

Michael Fox, scientific director of the Humane Society of the United States, has ably summarised the flaws in the assumption that productivity is a reliable indicator of animal wellbeing. Productivity can be attributed to a variety of factors, including genetic selection, energy and protein intake, artificial day-lengths and a number of other environmental and management variables, some of which can be shown to be detrimental to an animal's overall health and wellbeing. For example, studies on floor space allowances for broiler chickens have shown that

An outdoor unit for rearing weaner pigs. Such units need more labour, but capital costs are lower



"more pounds of live broiler can be produced per square foot" at higher densities, according to *Broiler Industry* magazine. Those same studies reveal that individual birds are more likely to die at higher densities. It must be remembered, too, that productivity in the animal factory is enhanced by antibiotics, growth stimulants and drugs which can mask or counteract problems of health and welfare that would not exist were it not for conditions in the factory farm.

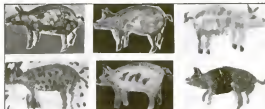
The second claim is that factory methods keep food costs down; but are production costs *really* lower in factory systems than in less intensive types of housing? And even if they are lower, are there not other costs, such as reduced food quality and adverse effects on human health, that might outweigh society's savings at the supermarket?

Real prices of animal products have declined since the end of the Second World War, and defenders of the new systems are quick to maintain that this was brought about by the trend toward intensification. Then they say, quite plausibly, that costs of production in intensive systems are lower than in conventional ones. But it is a mistake to believe that intensification is responsible for the relatively low prices of animal products today. Other factors, such as chronic overproduction in the milk and egg industries, grain surpluses and, especially in the broiler industry, mechanisation of processing and fierce price competition among brand leaders, have been the main forces in keeping prices down. In addition, agribusiness has made animals much more productive through genetic selection and improved feeds.

Studies that compare the various production costs among the different husbandry systems are proliferating on both sides of the Atlantic. Those available so far reveal that the economic advantages of factory systems are not as great as claimed. According to Robert A. Brown of the Food Animal Concerns Trust in Chicago, the studies "almost always show that total production costs are comparable whether animals

Animals are confined primarily for reasons of production efficiency, which translates into a more plentiful and economical supply of meat, milk and eggs with less seasonal variation in availability and price than would otherwise be the case.'

Council for Agricultural Science and Technology,
March 1980



'Rather large differences in housing type do not necessarily affect food-animal health and performance. Indeed, acceptable performance is possible in a wide range of accommodations—provided the facility and animals are managed adequately.'

Stanley Curtis, 1981

costs of different housing systems for poultry, swine, calves, dairy cattle and beef cattle. "In all cases," Brown says, "the costs of production are essentially the same in different housing systems."

One of the best comparative studies so far, by Paul Carnell for Earth Resources Research, concentrates on the on-farm costs—the costs of production to the farmer—in two types of operation where intensive methods have been most contro-

versial: eggs, and the production of so-called feeder pigs (young, weaned pigs ready for the fattening or finishing stage). Using "theoretical costings" derived from surveys, experimental results and farm visits, Carnell concludes: "... there is no neat, clear-cut relationship between intensity and cost in egg production and breeding pigs. There can be no doubt that economic forces have led to the development of intensive systems which have proved very competitive. However, the same economic forces have also been shaping the development of less intensive systems with the result that the economic advantages of intensive systems are not as marked as is often claimed or supposed."

Carnell had to use theoretical costings because of the difficulty in obtaining reliable farm data for the various types of systems. One study in Britain that used actual farm data, the Ministry of Agriculture Egg Yield Survey, failed to take into account differences in farm management ability, quality of buildings and other factors that tend to give intensive systems an edge. Because of the difficulty in finding enough commercial-scale, non-cage producers, such studies tend to compare small, backyard flocks of as few as a hundred hens with the largest, most well-equipped, commercial cage operations.

Paul Carnell developed methods of costing designed to illustrate the performance of well-managed new investment in a variety of commercial-scale operations. For pig breeding he found that production costs in the most intensive operations were only 11 per cent lower than in the least intensive operations. For egg operations the most expensive, free-range, were 97p a dozen, compared with 70p for the cheapest, in battery cages (see Figure 1, overleaf).

The main reason for the higher costs in the non-cage production systems is lower egg yield, and this is attributable to poorer environmental control, higher mortality and a larger number of lost and lower-quality eggs. Still, the price range is not as great as is commonly supposed, and some of the non-cage systems could be competitive. Why, then, are free-range eggs so much more expensive than cage eggs at the market? Not because free-range eggs are so expensive to produce, as is widely assumed, but because retailers tend to take a larger profit on health foods. Free-range eggs cost the retailer 14 per cent more, but the shops charge the public 30 to 45 per cent more.

Still, some non-cage systems compare favourably with cage systems. In North America, several studies have compared egg yields in deep litter *versus* cage systems and in most cases the litter systems did as well as or better than the cages. A 1978 study by the Swiss Centre for Poultry collected data on



Photo: Robert A. Brown, Food Animal Concerns Trust

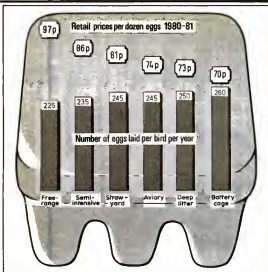


Figure 1 Battery hens produce more eggs a year, and these are cheaper in the shops...

the laying performance of 65 000 hens in 38 Swiss flocks, two-fifths of which were on litter, the remainder in cages. The results showed no difference in laying performance between the two systems (costs were not compared). Michael Fox says that some producers in the US prefer slat-litter housing to cage systems. They claim that they get better economic returns because the birds metabolise their feed more efficiently and live longer.

Meat production is another area where the conventional wisdom is being challenged. Data are emerging to show that production costs in the big, intensive systems are not necessarily lower than in the alternatives. Large dairy herds have higher costs per hundredweight (45.4 kilograms) of milk



... but much of the difference in retail prices is because shops take a higher profit

produced than do smaller herds because of higher capital costs. A survey in Iowa of 150 pig producers of all sizes showed that there was little difference in feed costs between high-profit and low-profit operations, but that high capital costs made the difference. Farmers with labour-saving, highly capitalised facilities paid \$9.25 more to produce a hundredweight of pork than did pig farmers with simpler operations. This gave factory farmers lower profits, by \$20 per pig, than their counterparts with low-capital, high-labour operations (see Figure 2).

In Britain, Quantock Veal, which supplies 90 per cent of the retail veal market, has abandoned rearing calves singly in crates or stalls in favour of straw-bedded group pens. The

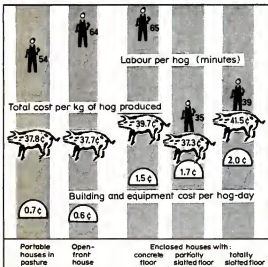


Figure 2 The various costs of raising pigs involve a trade-off between labour and capital, which means that the most intensive system does not necessarily produce the cheapest pork



'The poultry industry demands retention [of the battery cage]. Any other system is bound to result in greatly increased egg prices.'

Sir Richard Butler, president of the National Farmers' Union, July 1981



Chris Orr

'In most cases [deep-litter] systems did as well as or rather better than cages.'

Paul Carnell, 1983

changeover has nearly halved housing costs to farmers, and reports indicate that the calves are healthier and that veterinary bills have been reduced by about 65 per cent. Forty per cent of the members of the National Association of Veal Producers in Britain have adopted loose housing in groups as a more profitable way of producing veal, without recourse to arguments about welfare.

The goals of minimising production costs to farmers and prices to consumers are desirable ones, but if they are blindly pursued in livestock and poultry production we may be ignoring other important concerns. Public health is now entering the lists as new evidence emerges to link drug-dependent factory methods with human health problems.

By far the greatest threat to health posed by factory methods is the practice of feeding subtherapeutic doses of antibiotics to animals. These additives enhance growth and



Gordon Cusack/Farmers Weekly

These are not free-range hens. They are young birds maturing outdoors until ready to lay

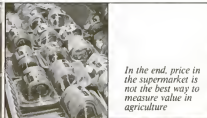
reduce the incidence of disease in crowded facilities. The practice has been under fire for years because according to some experts, the flooding of the environment with antibiotics accelerates the evolution of new strains of pathogens that are immune to the "wonder drugs". Proponents repudiate these claims, but recently a study conducted by the Federal Centers for Disease Control in Atlanta, Georgia, showed that resistant bacteria can move from farm animals into the food supply and cause grave, even fatal, illnesses in people. The researchers traced an outbreak of drug-resistant salmonella infection among 18 people in four Midwestern states to a South Dakota beef herd that had been fed antibiotics. Eleven of the victims were hospitalised and one died.

Although the use of antibiotics is restricted in Britain, nearly half of the 16 thousand tonnes produced each year in the United States is fed to farm animals. The US Food and Drug Administration estimates that about 78 per cent of the meat and eggs consumed in the country comes from animals raised on antibiotic-laced feed.

As a result of the routine use of antibiotics, growth promotants and other additives required by factory conditions, the incidence of chemical residues in animal products is increasing, and meat inspection programmes are inadequate to contain the problem. A report published by the US General Accounting Office in 1979 showed that 14 per cent of meat and poultry sampled by the Department of Agriculture contained illegally high levels of drugs and chemicals. Many of these substances are known to cause cancer, birth defects or mutations. Because of their reliance on chemical shortcuts to animal health and productivity, factory systems appear to be a major source of a dangerous new kind of pollution in our food supply.

I believe that the financial benefits of factory farms are exaggerated, and furthermore, that they produce unhealthy animals and poor-quality products; to offset these effects factory farmers must employ an arsenal of antibiotics, hormones, drugs, chemical additives, colouring agents and other substances that may threaten human health. When one considers the potential magnitude of these health problems and the social cost of dealing with them, the food produced by factory methods may well be too expensive—regardless of its price at the market. □

Jim Mason is a lawyer who contributed a chapter on factory farming to *In Defence of Animals*, edited by Peter Singer and published by Basil Blackwell recently.



In the end, price in the supermarket is not the best way to measure value in agriculture

How Akeron/Farmers Weekly



Kath Huggell/Farmers Weekly



Molten to the core

Six years ago today, a nuclear reactor in Pennsylvania gave us the world's worst nuclear accident. Attempts to clean up the mess are more a tedious chore than an experiment in nuclear technology. But the core of the reactor continues to throw new light on the "China syndrome"

Christopher Joyce

SIX YEARS ago today, the operators of a nuclear power station at Three Mile Island in Pennsylvania were trying desperately to bring their reactor under control. The core of the reactor had heated up like the element in an electric kettle that had boiled dry. During the confusion that followed, the reactor's operators did the wrong things at the wrong time. By the time they brought the reactor under control, the rosy expectations of the nuclear power industry in the United States lay beneath a pile of melted rubble.

The first incident in the events at TMI was at 0400 hours on 28 March 1979. A valve stuck open and cooling water started to escape from the reactor's primary cooling circuits. Errors by the operators led to the core being uncovered. The fuel overheated and was badly damaged. Highly radioactive steam escaped into the main containment building. The core, which was 3.7 metres high, was never completely uncovered, but the water level fell to about one metre. This is thought to have occurred 100 minutes into the accident, and the core was probably uncovered for nearly two hours. Even after they had filled the core with water, the operators could not keep coolant circulating to remove the heat produced by radioactive decay of fission products—the fission reactions were halted within seconds of the initial alert. It was another 16

hours before the operators finally established a "stable cooling mode".

What took minutes to create will probably require a decade to clean up and even longer to live down. The cost to TMI's operators, General Public Utilities Nuclear (GPU), taxpayers, electricity customers in the region and the nuclear industry will run to at least \$1 billion. The jury is still out on exactly what happened in the core (see Box 1). However, Edwin Kintner, the executive vice president of GPU Nuclear, who now runs the cleanup, says that nuclear engineers were not surprised that the reactor vessel withstood the partial meltdown of the fuel. As for cleaning out the plant, "We're answering pedestrian types of questions," says Kintner, like how best to scrub radioactive contamination off walls. "It's like cleaning out a stable—it's not as exciting as riding the horse, but it has to be done." The money going into the cleanup is an investment in the image of the nuclear industry. Unless there is another accident of similar proportions, that small (by nuclear standards) fortune is buying little of technical use.

The money is, for the most part, buying back the nuclear industry's reputation. Despite wishful thinking by a few diehards, TMI's Unit II reactor, one of two at the power

SINCE late 1983, metallurgists have been poring, like high priests studying sheep entrails, over a handful of debris from the reactor's core. Late last month, they discovered what GPU, which operated the reactor, had previously discounted—the core actually began to melt during the accident.

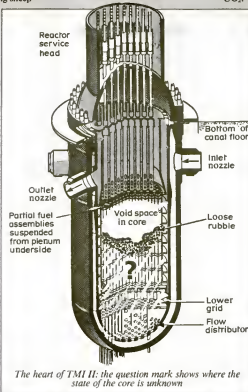
Meltdown is a nasty word in the reactor business. Until now, engineers at Three Mile Island referred to "liquefaction" of the fuel pellets of uranium oxide (UO_2) and the rods of zirconium alloy that contain the pellets. The latest analyses of the bullet-sized bits drawn up from the core in 1982, however, show that temperatures reached at least 2815°C .

Zirconium melts at 1882°C . At that point, the pellets of UO_2 fuel liquefy in the zirconium—like grains of salt dissolving in hot water, explains Willis Young, an engineer who manages the Department of Energy's programme in Idaho analysing fuel from Three Mile Island. As the temperature rose in the core, this mixture of UO_2 and Zr alloy and then ZrO_2 eventually melted at about 2590°C .

GPU had claimed that "liquefaction" is not a real meltdown. Alone, UO_2 does not melt until the temperature reaches 2815°C . But, last month, the laboratory in Idaho, working with the nuclear company EG&G, discovered bits of melted UO_2 standing alone. They show classic signs of melting: large, granular structure, like foam, with large pores and rounded particles.

GPU's officials and many of the scientists who work within the nuclear industry have no trouble finding a silver lining in the discovery that the fuel melted. A typical observation is that of George Haynor, a metallurgist and supervisor of failure analysis at Babcock & Wilcox, the company that built the reactor. "The most interesting thing is that you can have an

1: Melting point



The heart of TMI II: the question mark shows where the state of the core is unknown

accident as bad as TMI, and it was terribly bad, and still maintain integrity of the plant," he noted. "It shows that the China Syndrome [a meltdown through the concrete base of the plant and into the earth below] is not true."

The core is still giving up its secrets, if reluctantly, and many are puzzling. For example, why didn't melting fuel burn through the core former? This is the innermost protective wall of the reactor vessel; it

melts at much lower temperatures than UO_2 . Apparently, the most intense heat stayed at the centre of the core.

One possibility involves the core's rods. A pressurised water reactor sports an array of control rods, made of silver, indium and cadmium, and axial "shaping rods" of boron carbide. The rods hang among the fuel rods, where they modulate the nuclear reactions and shape the spread of the reactions, and hence the production of heat by the fissioning uranium.

As the level of coolant dropped during the accident, many of these rods shattered or melted. Photographs taken through the silty, boronated water that keeps the debris cool show their brittle remains, pointing down into a 1.5-metre void like stalactites in a cave. At the bottom of the void is a pile of fine rubble, with few recognisable pieces. Under the rubble lies a brittle, fused mass. About one-half of the core was broken into pieces.

Even in their destruction, the control rods may have been useful. Haynor suggests that as they shattered and mixed with fuel, stainless-steel parts and zirconium fuel rods, the rods formed a ceramic-like insulator that effectively shielded the outer parts of the core.

Workers made a more alarming discovery last month, however. They found another pile of fuel rubble, perhaps as much as 20 tonnes, at the very bottom of the high pressure vessel (see diagram). They had lowered a camera, now a routine exercise, into the vessel, this time to probe the annular space just inside the outer vessel wall. Unexpectedly, the camera bumped into pieces of debris the size of cricket balls lying beneath the flow distributor, a perforated metal plate like a colander that distributes coolant up through the core. No one knows how they got there.

station, will never operate again. Why not just seal it up and walk away? Though the least costly option, such a conspicuous entombment would be a glaring monument to nuclear power's biggest blunder. It would also turn the reactor into a high-level waste repository, something local residents will not stand for.

So GPU must clean up its mess. The company hopes it can thus salvage its companion reactor, TMI Unit I, which, though unscathed, has been closed since the accident, awaiting an official verdict on GPU's competence to run it. Ultimately, the nuclear industry, which is reluctantly sharing the cost of the cleanup, must shut the door on TMI II before people will begin to forget the incidents of 28 March 1979.

After the accident and the recriminations that followed, the Nuclear Regulatory Commission in Washington overhauled rules for training reactor operators and for the design of control rooms, the two main culprits in the events at TMI. Throughout the industry, there were myriad refinements to

operating procedures. The accident already has changed the way nuclear plants are run. Control rooms have been redesigned to simplify and centralise the information available to the operators, who are now trained more thoroughly than before. The training programmes now includes simulators that teach operators the underlying physical principles at work at the entire plant, rather than simply evoking rote responses "by the book".

The two reactors at TMI are located on an island not quite three miles long, at a narrowing in the Susquehanna River. Access to the island is closely monitored. No visitors go into the containment; the closest you get is a windowless concrete building nearby, where you can watch, via remote video, white-suited workers patiently cleaning house.

It was a year after the accident before anyone could re-enter the containment building. During the accident, large amounts of radioactive material leaked into the main containment building. The operators thought that a valve was

IN 1975, a landmark was set by a study in the US of how much radiation might be released in the event of a serious accident at a nuclear power plant. Rules governing the safety of nuclear power plants and the setting of a 10-mile evacuation zone around them evolved from the study, known in regulatory vernacular as "WASH-1400". Now the validity of that study is beginning to crumble—but not necessarily in the way the nuclear industry would like.

In September 1984, the first comprehensive review of WASH-1400, conducted at the request of the government's Nuclear Regulatory Commission (NRC), appeared to ring a happy note for nuclear power. Two of its conclusions were of particular interest.

First, radioactive iodine and caesium, among the most dangerous and volatile products created in a fissioning core or uranium, are not as nimble as previously expected. Should a reactor vessel containing the core be breached and release these products into the containment that houses the reactor, they most probably will dissolve in cooling and quenching water. If released in the form of an aerosol, they adhere to surfaces inside the containment and stay put.

In fact, just such a sequence probably occurred at Three Mile Island during the accident—a principal reason for undertaking the review. Surprisingly, although large amounts of iodine escaped from the reactor's core, very little of it left the containment building. The iodine, it is thought, escaped into the containment's chemically reducing atmosphere (due to

2: Time to relax

the presence of water and hydrogen) and became iodide, which readily dissolved in water. Caesium became caesium hydroxide, which has been found to interact irreversibly with surfaces.

In effect, the containment building acted like a huge radiation sink. That has proven good news for the public and industry's reputation if bad news for GPU, which must now clean fission products out of walls and floors.

The study's second finding was that the containment building itself, usually a combination of steel and concrete, is tougher than originally calculated, a conclusion drawn from better mathematical models. It is not likely to break from the internal temperatures and pressures that might occur even in a severe accident. Even if it were to break, so long as it held for a few days after an accident, most of the dangerous radionuclides would be that time have dissolved in water or adhered to structures inside.

The American Nuclear Society (ANS), which represents the industry and sponsored the study, cited it as proof that reactors are "overbuilt" to satisfy unnecessary safety rules. But the NRC wanted to await the results of yet another study, from a more neutral group, the American Physical Society. Late last month, the society concluded its work, in essence agreeing with the ANS's main conclusions. But it refused to endorse industry's request to reduce the size of the 10 mile evacuation zone around plants. It disagreed with

ANS's conclusion that radionuclides released during an accident might be as little as one-tenth to one-thousandth the levels predicted by WASH-1400.

The APS group raised several questions that it said need answering before the NRC can relax the safety rules. Little is known yet about the type and amount of fission products that would be released from a meltdown in which the core drops through the bottom of the reactor, evaporates quenching water below, then continues to burn into the concrete base of the building.

A molten core's interaction with concrete probably would release non-volatile transuranic products, such as plutonium, and lanthanides (rare earth elements with atomic numbers 57 to 70). These are biologically dangerous. Or, if a runaway reaction is checked, radioactive aerosols deposited on surfaces in the containment might become suspended again as a result of a sudden fall in the pressure of the containment. Nor was the APS group comfortable with the computer models that form the basis of reactor-safety research, noting that few have been verified with actual experiments.

The NRC now must weigh the two studies and decide whether to grant industry's request for regulatory relief. Anti-nuclear groups are vigorously opposing any such move, pointing to the APS's equivocal conclusions as reason to tighten, not relax, rules on emergency planning and safety design. There is a good chance that, despite scientific consensus that accidents are unlikely to be as bad as predicted, little will change for nuclear power. □

closed but was actually stuck open, dousing the multi-storey building with water and steam carrying radioactive fission products, including iodine, strontium and caesium. The steam pervaded the walls, floors, catwalks and equipment.

Four million litres of radioactive water filled the containment and an auxiliary building. Two-and-a-half million litres sat in the building's basement, 2.5 metres deep. The walls of the basement were coated with protective paint up to 1.5 metres. Between that mark and the high-water mark, they bore a one-metre strip of highly radioactive material known as the "bathtub ring". Porous concrete acted like an ion exchanger, trapping fission products as the water percolated through it. Radiation levels were running at hundreds of rems per hour (rem is dose to the body; five rems is the legal maximum per year for workers in the nuclear industry).

Although the water has been pumped out, radiation from a green layer of sludge, 7.5 centimetres thick, and from contaminated concrete keeps the basement "hot as a pistol", as one of GPU's engineers described it. So far only wheeled, remote-controlled robots have ventured down for a look.

The most recent forays into the containment building required several men to stand on a heavy, water-filled radiation shield. The shield, part of the equipment designed for the cleanup, has been laid over the top of the pressure vessel. Through holes once used to lower instruments into the core, a worker carefully feeds a cable, at the end of which is a camera about 3 centimetres wide and 30 centimetres long. Working under direction from observers viewing the inside of the vessel through the camera, he feeds the cable around the labyrinth of broken fuel rods and assorted rubble. From these come murky scenes reminiscent of photos of underwater wrecks.

Over 900 people are working on the cleanup, three times the number needed to run the reactor. Exposure to radiation

is a constant threat, but GPU has kept everyone to within one rem per quarter, below the federal limit. A computerised system keeps track of exposures and can calculate individual doses in moments. Dosimeters measure daily and cumulative doses of gamma and beta radiation. Alpha radiation is dangerous only if inhaled. Readings in the containment buildings show almost none is present. It is probably because the materials that produce it are trapped in pipes. Alpha radiation is not highly energetic, thus cannot penetrate metal, concrete and so on. Gamma radiation penetrates metal, protective clothing, and skin. Beta radiation is relatively high-energy, will penetrate skin and can damage eyes. Both beta and gamma radiation are present in the containment building.

Because of the radiation levels, workers have to wear protective clothing. Until recently, the building could not be cooled and, as summer temperatures soared toward 40 °C, workers baked inside their bulky white protective garments. Two workers were taken to hospital with heat prostration. Since then, GPU has learned to cool both suits and the containment.

While workers attacked the containment with high-pressure hoses, scrubbers, scabblers (to break up and remove the top few centimetres of cement) and vacuum cleaners, engineers processed the radioactive water. GPU discovered that conventional ion exchangers could not economically handle the high level of radioactivity (150 microcuries per millilitre) in the water they pumped out of the auxiliary building and the basement. The water was many times more contaminated than anything normally produced at power stations. Contaminated water is usually run through a stainless-steel tank containing organic resins which filter out radioactive material. The resins are then disposed of as mid- or high-level radioactive waste. But the water at TMI would have required too much resin, which would have been very expensive. So the cleanup team has used inorganic zeolite

One technical breakthrough in the cleanup of TMI II was the provision of pockets on protective clothing. The pockets were for ice to keep the operators cool



filters. These resist decomposition even after absorbing high amounts of radioactive material. Zeolites are also very specific for caesium and strontium, two of the most troublesome fission products in water. The zeolites packed as much as 60 000 curies of radioactive waste in a single "liner". These liners were sent in steel containers to the US Department of Energy's research laboratories in Hanford, Washington State. Some of the liners were made into glass "logs" as part of the department's research into methods of disposing of radioactive waste.

The toughest job is yet to come, locating 100 tonnes of fuel scattered throughout the primary cooling system. About 70 tonnes remain in the core. Much of the rest is assumed to have been pumped throughout the system, in pipes and the huge steam generator where superheated water made steam to turn the turbines. Technicians must seek out this fuel with spectrometers, these are modified to reach into tight spaces. The spectrometers will seek gamma radiation given off by cerium-144. Uranium does not show up on the instruments, but cerium is likely to accompany pieces of the fuel debris and it has a characteristic gamma-ray spectrum. As for the core, engineers will build a special cutting tool and bins to break up and haul away the brittle, solidified mess at the bottom of the reactor vessel. These tools probably will never be used again.

The course of the cleanup has not been as smooth as GPU likes to describe. The company's critics had a field day in 1982 and 1983 when federal investigators accused GPU of circumventing safety precautions to hasten the cleanup. Three workers claimed they were harassed and either fired or moved because they questioned management's dedication to safety. (However, GPU fired one worker for conflict of interest, he was a consultant with another firm while working at GPU. The Nuclear Regulatory Commission did not dispute this.) The violations were related to safety rules with equip-

ment such as the overhead crane used to lift the head and plenum off the reactor's pressure vessel. The incidents were not too important, but they did reflect badly on the management of the cleanup operation.

Since then, most of those responsible have left. Kintner, a veteran of the nuclear navy and the breeder reactor programme with a reputation for efficiency, has taken over the cleanup. "He's a tough cookie," observes Thomas Cochran, a physicist with the Natural Resources Defense Council. "If anyone can get the job done, he can," he says.

Recently, the head of the pressure vessel has been taken off. The 55-tonne metal plenum, 3.5 metres in diameter, that covers the vessel has been jacked up a few centimetres in preparation for removal. GPU is building a rotating platform on which canisters will sit. This "carousel" is to be lowered into the core holding five canisters. Using long-handled grapples, workers will load the canisters with large pieces of debris. Later, they will extend cutting tools into the core to break up the fused mass beneath the debris and will load that into canisters. Eventually, workers will lower stainless-steel canisters into the vessel, and, using long-handled grapples and vacuum cleaners to suck up loose debris through long tubes, will load them with debris. Each canister, 3.7 metres high, will be sealed, then hauled up, shielded with lead sheaths, and manoeuvred into the canal that formerly carried exhausted fuel rods. Then the debris will go to the Department of Energy's laboratories in Idaho for study and burial.

Most of the cleanup has proven to be simply a dirty, tedious chore. The protective clothing and robots developed for the dirtiest work are basically off-the-shelf items common to decontamination jobs in the nuclear weapons industry. GPU has made much of the educational value of the cleanup. A cynical view, like that of Robert Pollard, a nuclear engineer who now works for the Union of Concerned Scientists in Washington, is that the company must claim value in the cleanup so it can shift some of the enormous costs onto others.

If so, GPU and its partner in the cleanup, Bechtel, have partly succeeded. After some reluctance, other utilities have agreed to contribute about \$150 million. The Department of Energy will put up almost \$200 million. Even Japan has promised \$18 million, and has sent a bevy of engineers to the site to observe the cleanup.

Much of what has been learnt is mundane. For example, when asked for some of the most useful discoveries made during the cleanup, an official with the Nuclear Regulatory Commission replied "Paint." It was discovered that painted concrete absorbs far less fissile material than bare walls, and contaminated paint could in some cases simply be stripped off "like a woman with a face peel," he observed. "I know a guy from Commonwealth Edison [a nuclear power utility] who went to TMI, came back and bought \$300 worth of paint and started painting everything."

Opinions vary widely over what the most important lesson has been from TMI. Clearly, the events the week after 28 March, 1979, have shown how *not* to run a reactor when the core of a reactor unexpectedly loses its coolant. As for the cleanup, it is to continue until 1988. By then, GPU must decide what to do with the plant. It may leave some radioactive contamination behind, an amount yet to be determined, and board it up. Or it may try to convert it to another use. In the meantime, the core will continue to turn up more surprises. For example, analysis of the fuel debris has shown that rather than collapsing into a single mass of melting instruments and fuel, the overheated core contained pockets and corners of relative coolness and stability. But, as material solidified in the frothing coolant that rose and fell during the reactor's worst moments, it moved in ways not predicted by computer models. Ultimately, the core experienced a partial meltdown, but the reactor proved capable of withstanding the test—in fact, rather better than the people confronted with the accident. □

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Geneticists develop DNA fingerprinting

Jeremy Cherfas

DNA "FINGERPRINTS" that can distinguish between 54 members of a single family have been developed by molecular geneticists at the University of Leicester. The fingerprinting technique was discovered by Alec Jeffreys and colleagues at Leicester's genetics department. It promises to develop into the most powerful method of DNA identification known to date. The technique will provide geneticists with a new tool to study the mechanisms of recombination that occur during cell division as well as giving them new insight into genetic diseases.

Human DNA does not vary very much between different members of the species; roughly 999 out of every 1000 base pairs (the letters of the genetic code) are the same in two unrelated individuals. There are, however, some regions that seem to be more variable, with a different structure in different individuals. One is near the insulin gene, a second in the α -globin gene, and a third in the cancer gene known as *c-Ha-ras-1*. Jeffreys had previously isolated a fourth, which lies within one of the non-coding regions of the gene for myoglobin, a protein that stores oxygen in muscle.

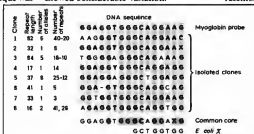
All of these so-called hypervariable regions have a similar structure. They consist of a short stretch, a few tens of bases, of DNA repeated a number of times. This is called a minisatellite because it resembles the much longer repeated sequences known as satellite DNA. Most of the difference between individuals consists of differences in the number of repetitions of the short sequence.

These differences show up when the DNA is digested with restriction enzymes, which recognise specific target sequences of bases and break the DNA there. Provided that the minisatellite does not contain the target sequence of the restriction enzyme the fragments created will vary in length—each according to the number of times that the minisatellite is repeated. The fragments can then be sorted according to length by gel electrophoresis.

Jeffreys decided to use his myoglobin minisatellite as a probe to search for other hypervariable regions. The technique involved mixing purified DNA from the minisatellite with the entire complement of human DNA. Any portions of the human genome that resemble the minisatellite probe bind to the probe. This results in hybrid molecules which can be isolated for further study. In this first search Jeffreys looked at the genomes of a father and mother and their daughter. The DNA had been fragmented with two restriction enzymes, *HinfI* and *HaeIII*, that recognise a four-base sequence which does not occur anywhere in the satellite sequence.

Several fragments turned up that hybridised to the probe. They were between two and six kilobases (kb) long, considerably

larger than the 0.3 kb fragments normally released by *HinfI* and *HaeIII* and they showed considerable variation.



Sequence agreement in the various minisatellites. Hatched areas indicate concordance between the repeats. The hatched parts of the common core indicate bases that are identical in all the minisatellites

Encouraged by this, the Leicester team used the probe to screen a library of about 30 000 DNA fragments representing the entire human genome. Forty clones hybridised with the probe and, of these, eight were selected at random for further study. All eight showed essentially the same fundamental structure; a repeated sequence similar to the myoglobin minisatellite. There were, however, two different sources of variation. First, the length of the minisatellite varied from 16 base pairs (bp) to 64 bp. Secondly, the number of repeats of the minisatellite ranged from 3 to 29.

These eight clones were then used as probes to screen a further 14 human genomes. The intention was to see whether any of the minisatellites showed variation between individuals. Four of the eight did, three especially so. These three turned up in between 5 and 8 distinct varieties in different individuals. The varieties, or alleles, differed in the number of times that the satellite sequence was repeated.

Calculations based on a variety of different possible models revealed that, in the hypervariable regions, the rate of exchange between DNA molecules is some 10 times faster than the rate normally seen when paired chromosomes exchange material during reduction division (meiosis). Two explanations could account for this. Either the exchange goes on at every division, not just meiosis, between sister chromatids (each chromosome is made of a pair of sister chromatids). Or there is something about the minisatellite sequence that promotes exchange, turning these regions into so-called recombination hotspots.

Taking all the different length minisatellite sequences from the eight clones, and aligning them with the original myoglobin probe sequence, Jeffreys uncovered an invariant core sequence of 10 bases. Every one of the clones shared this particular sequence, and the eight were also very similar over a longer stretch of 15 bases. This core identity of the different

minisatellites would certainly help to promote duplication of the region by unequal exchange. It might also actively promote recombination. Certainly the sequence resembles a region called χ found in the

DNA of the bacterium *Escherichia coli*. The χ region is believed to be a signal that causes recombination, and the core sequence of the minisatellites may be performing the same function in our DNA (see Figure c).

Knowing the core sequence enabled Jeffreys to contemplate a very selective probe, consisting entirely of repeats of this sequence, which would recognise other hypervariable regions in the genome that might have been missed by the myoglobin probe. Fortunately, one of the eight clones consisted of 29 repeats of an almost perfect 16 base core sequence. This was

purified and used to screen the DNA of 54 individuals drawn from four generations of a single pedigree. The results would be considered astonishing from the perspective of earlier knowledge about the variability of the genome (*Nature*, vol 314, p 67).

Each individual's hybridisation pattern was different from all others, a unique genetic fingerprint. The technique even resolved the two offspring of a marriage between first cousins, which would have been difficult with all previous methods. Particular fragments of DNA could be traced from each parent into some of the offspring, and back to that parent's own parents. This indicates that there is practically no homozygosity for the hypervariable regions; each region is present in two different versions in every individual. Furthermore, there was no tendency for particular bands to go from father to son or mother to daughter. This indicates that the hypervariable regions are not present on the sex chromosomes.

The pedigree survey even revealed a completely new mutant fragment cropping up in one of the children. (Paternity for this child was confirmed by several other tests.) The survey isolated some 240 different DNA fragments. One new one among them represents a mutation frequency of 0.004, a figure that agrees quite well with the calculated value of 0.001.

The procedure is the subject of a patent application and it is not hard to foresee many applications for DNA fingerprinting. Perhaps most important, it will enable geneticists to search through pedigrees for markers associated with particular genetic diseases. The markers could then be used to pull out the relevant bit of code and study it further. Fingerprinting may also find a use in paternity testing, in forensic medicine, and in studying population biology, inbreeding and demography. Not least, the hypervariable minisatellites should provide an insight into the mechanisms of recombination. □

Insect life in an Indonesian rainforest



Chris Schofield has returned from the Royal Entomological Society's Project Wallace Expedition in Sulawesi

SPLIT a log in the rainforest and you will find termites. And scurrying on the forest floor, or up tree trunks, ants make their presence felt. Because they are so common, ants and termites are a food resource and, in the competitive world of the rainforest, you might expect that something will have adapted to exploit them. In this case, the exploiters are phorids—tiny, black, parasitic flies with cunning habits.

Henry Disney, a research fellow for the Field Studies Council, is presently working with the Project Wallace Expedition in northern Sulawesi (New Scientist, 3 January 1985, p 12). Ten years ago, he realised that, in spite of accepted dogma, most phorids are parasites or specialised predators of other insects.

Phorids are usually classed as saprophages, organisms that feed on dead and rotting organic matter.

In Sulawesi, Disney watched foraging ants and began excavating termite and ant nests, seeking phorids within them. This revealed small wingless "gallery phorids" which do not seem to parasitise anything and probably feed on fungus in the nests. But, Disney says, termites damage trees. When the weakened branches fall, as they frequently do, groups of termites become exposed and a few of the termites are damaged in the process.

It seems that wounded termites attract ants and phorids, as well as lizards and some predatory beetles. So Disney's technique now is to crack open termite-riddled logs over a large white sheet and then

patiently watch to see what happens.

There are so many ants, termites and phorids that Disney has not yet identified them all. He speaks of "squatter ants" which take over termite nests in trees. These are parasitised by the "spear-gun phorid" which darts in to stab them with its "spring-loaded" ovipositor. "Highwayman phorids" have a different strategy, they land near a squatter ant and then run up beside or behind it before stabbing and laying an egg in the unfortunate ant.

When Disney breaks open a log to expose termites, phorids usually appear within 2-3 minutes. The first two species are "glutton phorids"—they do not seem to parasitise the termites, but they feed on fluids exuded from termites damaged as the log cracked open. Then along come the "con-flies"—phorids that land, run up to a termite and prod it to attract its attention. Termites are blind and Disney believes the con-flies have glands above their ovipositors which produce a scent to lure the prodded termite away from the main group. The con-flies keep turning back to prod the following termite until it is some distance from the main group; they then attack and paralyse the termite while laying a single egg on it. The egg hatches and the larva develops to an adult phorid in about 10 days, but during this time the dead termite does not rot so, presumably, the female injects some form of antiseptic with her egg. Con-flies parasitise worker or soldier termites, but they must beware of nasute termites, a caste which, if disturbed, can spray lethal chemicals from a nozzle in the head.

In deference to the expedition, the most common ants—large black poneries—are of course denoted "Universal Wallys". Disney has found two species of phorid in their nests. The Universal Wallys are also plagued by small brown "scrounger ants" which snatch food from the Wallys and run down small holes where the Wallys cannot follow. The parallels with human behaviour seem obvious!

Life on dead bodies and dung

IN THE rainforest, dung and dead animals represent rich sources of food for a wide range of insects. There is extreme competition for dung and carrion, so excrement disappears within hours, bodies within days.

Iika Hanski, of the University of Helsinki, has been studying what happens to dung and carrion, during his stay with the Project Wallace expedition to Indonesia's rainforest. He finds that blowflies can arrive at fresh human excrement within about 30 seconds of its deposition, but the excrement usually takes about three hours to be consumed by scarab beetles. Geotrupid beetles in Indonesia seem not to attack dung and carrion, unlike their temperate relatives. Only one species of geotrupid was previously known from Sulawesi, but Hanski and Peter Hammond of the British Museum (Natural History) have already found four species that seem to feed on subterranean fungi.

When an animal dies, its body is attacked within minutes by competing blowflies, ▶

Primitive grasshoppers eat primitive plants

GRASSHOPPERS probably first hopped on Earth towards the end of the Palaeozoic, during late Silurian and Devonian times, when only primitive plants were around. As more advanced plants evolved, so more advanced grasshoppers evolved to feed upon them, leading to the modern species which abound today. But some grasshoppers remained primitive, specialising to feed on plants such as algae and ferns which are shunned by most modern grasshoppers.

Ruth and Robert Blackith, of Trinity College, Dublin, have been studying these primitive grasshoppers for over 20 years. Although Robert admits to being over 60, both are active members of the Project Wallace Expedition in northern Sulawesi.

Giant flea from Sulawesi

MURID rodents in northern Sulawesi carry a rich fauna of ectoparasites. Lance Durden, of Vanderbilt University Medical School, Nashville, and presently working with the Project Wallace Expedition in the Dumoga-Bone National Park, has already captured 14 species of small mammal including two species of shrew and five species completely unknown to the rest of the world. One of the rats may prove to represent a new species. All the mammals carry their own community of ticks, mites, fleas and lice, which Durden carefully removes before marking and releasing the mammals back into the forest.

Apart from common rat fleas, which have an almost worldwide distribution, Durden has found five species of pygiopsyllid flea on the endemic rodents. Pygiopsyllids are mostly parasites of Australasian marsupials, so it was surprising to find so many species on Sulawesian rats. One male pygiopsyllid from an endemic rat, *Rattus helwadii*, is clearly a new species. At over 5 mm long it is almost the largest flea known. (Most fleas are 1-2 mm long; the largest, *Histricopsylla talpe*, can reach 8 mm long.)

They have already found seven species of Tetrigid grasshoppers grazing on lithophytic algae in deep, shaded gullies in the forest. The Blackiths have also found one species of Tridactylid grasshopper which eats algae. But in this case, the tridactylids burrow in sand by the rivers; they ingest sand in order to feed on the algal bloom and, like earthworms, leave distinctive "casts" of earthy faeces.

Finally, the Blackiths are studying one of the most primitive Eumastacid grasshoppers: *Karnydia gracilipes*. This species is found only in Sulawesi. It has no wings and holds its rear legs at right angles to the body, unlike modern grasshoppers. In other areas eumastacid grasshoppers feed on ferns, but the Sulawesi species seems to feed only on *Selaginella*, a primitive fern-like plant sometimes known as *Lycopodium*. Eumastacids have brightly coloured genitalia and the males produce 800 times more sperm than modern grasshoppers. This means that most of the sperm is wasted and the Blackiths suggest that in this way, any abnormal sperm will tend to be lost, reducing the likelihood that any chromosome rearrangements would be passed to the offspring. This might explain why these primitive insects have remained virtually unchanged since the Palaeozoic era.



Primitive grasshoppers still live on algae

David Pearson/SPR

Volcanic ash helps to date hominids

IN THE hard world of palaeoanthropology, theories and reputations can hinge on the dates given to early members of our human family. But good dates for hominid sites are far from easy to obtain and are frequently disputed. A useful new way of clarifying when hominids were around in East Africa has come from an unusual source—oozes in the Gulf of Aden.

A team of American geologists with access to the facilities of the Deep Sea Drilling Project has matched volcanic ash in sediments at the bottom of the Gulf with four consolidated layers of ash (tuffs) at hominid sites in the Rift Valley, among them Hadar in Ethiopia and Koobi Fora near Lake Turkana in Kenya (*Nature*, vol 313, p 306). On land, dates are obtained from the tuffs themselves—usually by the potassium-argon technique. In the Gulf of Aden, the deep-sea oozes have provided the key dating information.

Hadar was where the partially complete fossilised skeleton of Lucy and several hundred fragments of other early hominids were found in the 1970s by Donald Johanson's team. For a decade, scientists have argued about the age of this large collection of hominids. This controversy could now be quietened, but perhaps not stilled, by the oceanographic evidence that A. M. Sarna-Wojcicki's team at the US Geological Survey and University of Utah has obtained in the Gulf of Aden.

The deep-sea dates put forward by these American geologists point to all the Hadar hominids being younger than 3.3 million years. This figure is in broad agreement with recent land-based evidence which places the hominids at between 3.2 and 2.9 million years old. Both estimates are out of line with Johanson's preferred time range of 4 to 3 million years for hominid occupation of the Hadar site.

The Hadar individuals lived and died near an ancient lake in the Rift Valley. Interbedded with the sediments in which their remains were fossilised are tuffs and

lava flows. The tuffs are important marker horizons because they can be traced for several kilometres. Each has its own chemical composition and some have been chemically analysed and "fingerprinted". Two years ago, Frank Brown of the University of Utah, one of the team reporting the Gulf of Aden findings, found that the Tulu Bor Tuff at Koobi Fora is similar to the more northerly Sidi Hakoma Tuff underlying the Hadar hominids. His work suggests that both tuffs originated from the same ashfall.

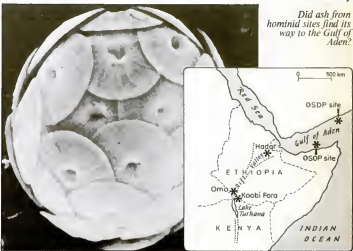
Could ash from this and other volcanic eruptions during early hominid times have blown from the Rift Valley into the sea? The Gulf of Aden, which lies almost due east of Hadar and is north-east of Koobi Fora, was the obvious place to look for it. Sure enough, eight layers of ash were found in deep-sea cores obtained by the Deep Sea Drilling Project. The ash is seen in rare but distinct bands in ooze formed by the calcareous skeletons of single-celled algae called coccolithophores. These microscopic organisms live in the plankton in large numbers. When they die, their remains (coccoliths) sink to the sea bottom and form the bulk of oceanic sediments.

These so-called nanofossils are important stratigraphic markers on a world scale because different groups characterise successive intervals of geological time. The coccolith sequences ("nanofossil zones") form a standard biostratigraphic scheme against which geologists can correlate dates of other fossil organisms found on land and in deep-sea sediments.

The coccoliths in the Gulf of Aden oozes thus provided the key to the dating of the ash layers. Petrological and electron microprobe analyses matched the volcanic deposits. The main result of this work is that the age of the Tulu Bor Tuff, previously uncertain, can now be placed at less than 3.4 million years. By inference, the Hadar hominids are younger.

Sarah Bunney

Did ash from hominid sites find its way to the Gulf of Aden?



A coccolithophore from the north Pacific



Ants can feed on bird droppings

◀ scarab beetles and ants. Experiments with dead rats show that, although there are many species of foraging ant, they are not always the first to reach a dead body. However, if they are the first, they usually prevent other scavengers getting there. Often, blowflies such as *Lucilia*, *Chrysomya*, and *Phormia* reach the carcass first, where they feed and breed. Sarcophagid flies may arrive later to deposit their eggs; their larvae then kill any blowfly larvae which are present.

One species of silphid beetle, *Nicrophorus*, is common in Sulawesi's lowland forest. These beetles rapidly bury a carcass in order to avoid competition from blowflies and ants. The carcass then becomes a larder for the developing beetle larvae. Scarab beetles usually feed on dung, but, in Sulawesi, some of them also feed and breed on carrion. Like silphids they partially bury the carcass to avoid competition. One scarab, *Gymnopleurus*, which normally rolls dung balls away into holes where it lays its eggs, also tries to roll away balls of flesh to avoid competition from other scavengers around the corpse.

Because dead bodies and dung attract so many scavengers, they also attract predators. Many staphylinid and histenrid beetles prey upon carrion beetles and blowfly larvae. Sulawesi's forest is unusual in having many species of small lizard which also prey upon beetles as they attack dung and carrion.

Chris Schofield lectures at the London School of Hygiene and Tropical Medicine

Vacuum cleaners

PENIS injury, brought about by vacuum cleaners, is in the news again (*Urology*, January 1985, p.41). This type of injury received an unusual amount of public interest about four years ago (*New Scientist*, 17 July 1980, p.224 and 7 August 1980, p.476). Dr Ralph Benson of the Mayo Clinic in Minnesota described five cases of significant injury to the penis all of which were caused by vacuum cleaners. He blames sexually orientated magazines for the increase in the number of penis injuries—their pages giving what he regards as dangerous testimonials to the practice of masturbation using vacuum cleaners. One injury was so severe that the glans was destroyed.

For the uninjured but ineffective penis, French doctors have developed a non-invasive method of measuring the degree of penile rigidity. The device consists of a metallic sensor that covers a third of the circumference of the penis. The sensor drives an electronic dynamometer which provides a numerical reading when 100 grams of penile tissue moves the sensor by 1 millimetre. A new unit has been appropriately coined to measure tumescence—the PENRIG (*Urology*, January 1985, p.80).

Sweetest substance

THE world's sweetest substance has been analysed to reveal the sequence and arrangement of amino acids that make it up. The work, carried out by researchers from the University of California at Berkeley and the University of Utrecht in The Netherlands, opens up new ways of exploring a little understood human ability—the sense of taste.

Using X-ray crystallography the researchers determined the chemical structure of thaumatin I, a protein isolated from the berries of a West African rain forest shrub known as katemfe. The berry has been used by Africans for centuries to sweeten foods such as bread and palm wine.

Sung-Hou Kim, professor of Chemistry at Berkeley, says that understanding the structure of thaumatin I will "allow the first effective studies of the precise molecular basis of taste" (*Proceedings of The US National Academy of Sciences*, vol 82, p.1406).

Plant-handedness

PLANTS have no hands, so it is difficult to see how they could be left- or right-handed. Yet some plants show definite "handedness", or chirality, and this feature is so strong in some species that a group of Indian scientists suggests using it to identify grasses.

Bir Bahadur, Mahender Reddy, Rammy Swamy and G. Narsaiah at Kakatiya University in Warangal, Andhra Pradesh, have studied chirality throughout the large grass family, the Gramineae. They looked at the way the first seedling leaf is folded either to the left or the right, and classified species as left- or right-handed (*Proceedings of the Indian Academy of Sciences [Plant Sciences]*, vol 92, p.279).

In 93 species in 67 genera spread over 11 tribes of Gramineae, a large number of grasses are left- or right-handed. However, some species are always neutral, and lack handedness. In other species, there is a tendency for only one type of handedness.

Costly booze

ALCOHOL abuse is costing Britain at least £1500 million per annum says Professor Alan Maynard, director of the Centre for Health Economics at the University of York (*British Journal of Addiction*, vol 80, p.27).

Maynard suggests that the cost to industry from sickness absence and absenteeism is between £176 million and £400 million. He adds that many heavy drinkers are likely to be heavy smokers as well. Maynard concludes that although the figures are essentially crude estimates their magnitude does place a considerable burden on society's scarce resources.

Messages through molecular space

HOW CAN one atom know what

John Emsley

another atom is doing when the two are at different ends of the same molecule? One clue to the way information is transmitted has come to light in studies of the biochemically important metalloporphyrin complexes that are related to the natural complexes in many proteins.

There are curious goings-on in the molecule dihydroxo-5, 10, 15, 20-tetraphenyl-

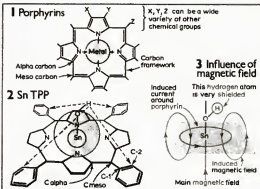
called through-space coupling.

The signals linking the two have been observed by nuclear magnetic resonance (NMR) spectroscopy which can detect atoms whose nuclei have the property of spin, such as hydrogen and carbon-13 (the stable but much less abundant isotope of carbon). Nuclear spin is very sensitive to the density of electrons around it and one nucleus can inform another nucleus of its state of spin by the effect it has on the electrons in the chemical bond between them. The message can actually be passed via other intervening atoms although these considerably weaken the signal, but coupling via one, two, three, and sometimes more atoms is detectable.

The masthead hydrogen on top of SnTPP, however, has no hope of influencing atoms of the benzene groups attached to position Z on the porphyrin, because coupling would have to go via the sequence of atoms $H \rightarrow O \rightarrow Sn \rightarrow N \rightarrow C_{\alpha} \rightarrow C_{\text{meso}} \rightarrow C-1 \rightarrow C-2$. Yet the chemists discovered that the seemingly impossible coupling of the hydrogen and C-2 atoms of the benzene rings is taking place. They deduce that this coupling must be directly through space rather than through electron-bond influences. They were able to prove this by modifying a common NMR technique. But the reason why through-space coupling occurs is due to the porphyrin molecule itself.

Place such a molecule in the strong magnetic field of an NMR spectrometer and the field induces an electric current in the porphyrin molecule around the central metal atom. This current in turn generates its own magnetic field which, as expected from the laws of physics, opposes the main field that is causing it. This locally-produced field shields the masthead hydrogen atom from the main magnetic field (see Figure 3) so much so that its signal is detected by the NMR spectrometer far outside the normal range.

When the carbon-13 spectrum is recorded it is necessary to uncouple or decouple the effects of all the hydrogen atoms in the molecule in order to get a clear picture of the various carbon atoms. This decoupling is usually done by pulsing the sample with the full spectral range of hydrogen frequencies. But in the case of SnTPP the masthead hydrogens are outside this range so they remain coupled and, surprisingly, they were coupled not only to the nearer carbons in the porphyrin but also to the C-2 atoms of the benzene ring. By changing the decoupling pulse to cover the masthead hydrogen the effect disappeared, thus proving its origin.



porphyrinatotin (IV), or SnTPP for short (Sn is the chemical symbol for tin), and these have been uncovered and reported by Lionel Milgrom and Richard Sheppard of Imperial College, London (*Journal of the Chemical Society, Chemical Communications*, p.350). Atoms in quite different parts of SnTPP have been discovered to be interacting with each other in a way that is totally unexpected, rather as if the tiny flag on top of the mast of a sailing boat were communicating directly with the rudder.

Grass is green and blood is red because they contain metal porphyrin molecules. Porphyrins are large planar molecules with a hole at the centre that can accommodate a metal atom. In chlorophyll the metal is magnesium, in haemoglobin it is iron. A large variety of natural and artificial porphyrins are known (Figure 1). For research purposes the simpler the porphyrin the better, and tetraphenylporphyrin (TPP) in which X and Y are hydrogen atoms and Z is a benzene group is particularly useful.

The versatility in the metalloporphyrins comes not by changing the metal, or the porphyrin surrounding it, but by changing the other atoms or molecules which also attach themselves to the metal above and below the plane of the molecule. The iron in haemoglobin carries out its function of distributing oxygen around the body by attaching O_2 to the iron atom.

Milgrom and Sheppard began with a tin-porphyrin complex to which they attached a hydroxyl group, -OH, to the tin (Figure 2). The hydrogen atom is rather like a tiny flag at the top of the molecule. What they then discovered is that information can pass directly between this hydrogen and the benzene groups of the porphyrin by a so-

TECHNOLOGY

Space telescope unveiled

Ian Anderson, San Francisco

AFTER eight years of delays and escalating costs, the space telescope is nearing completion in California. The cylindrical frame of the revolutionary telescope was unveiled last week by engineers at Lockheed Missiles and Space Company in Sunnyvale. It will be launched aboard the space shuttle Atlantis on 8 August, 1986.

When first approved by Congress in 1977, the telescope was due to be launched last month so that it could view Halley's Comet and identify "targets of opportunity" for the fly-by of Uranus by the Voyager-2 spacecraft. Then the cost was \$572 million. The latest estimate is about \$1.2 billion.

The telescope is due to be fully assembled on 3 March next year. The 2.4-metre primary mirror and 0.3-metre secondary mirror are already in place. Engineers are now mounting the five instruments that will be used to probe seven times deeper into space than existing ground-based telescopes. Still to arrive at Lockheed are the guidance sensors that will control the positioning of the telescope. The precision required by these sensors has been one of the main causes of delay in construction. Engineers are also waiting for the solar arrays that will power the telescope. British Aerospace is manufacturing these.

Tests to determine the ability of the telescope and its mirrors to withstand the vibrations of the launch are now under way. Further tests will be carried out in June, when the telescope will be placed in a thermal vacuum chamber and subjected to intense heat and cold.

Once in space, the telescope will explore 350 times the volume of space that can now be seen. The light it will receive will represent events that occurred up to 14 billion light years ago. The telescope will be deployed at an altitude of 593 kilometres with an inclination to the equator of 28.5 degrees. This orbit is well above the area where there are distortion effects from the Earth's atmosphere, so the telescope will view objects with 10 times the clarity of a ground-based instrument.

The heart of the telescope will be the mirror. Its surface is so fine that if it were scaled up the size of the Earth, none of its features would be more than 12.7 centimetres above the surface. Light entering the telescope will be reflected off the primary mirror to the secondary mirror 4.5 metres away. The secondary mirror will send the light through a hole in the large mirror, back to the scientific instruments.

The precision of the guidance sensors is also impressive. They will allow the telescope to point with a stability of 0.007 arc seconds. This is roughly equivalent to focusing on a dime in Los Angeles from a spot in San Francisco 700 kilometres away.

The instrumentation is so sensitive that to assemble the telescope, Lockheed has spent \$8 million to build what it claims is the world's largest "clean room". Giant fans in the eight-storey high room force the air through filters that can screen dust

particles 200 times smaller than the thickness of a human hair.

The European Space Agency (ESA) is building one of the five instruments on the telescope—the faint object camera. In



The space telescope in its eight-storey clean room

return, ESA will be allowed to allocate about 15 per cent of the telescope's observation time to European scientists. By electronically intensifying the images it sees, the camera will detect objects to the 28th or 29th magnitude, about five magnitudes higher than Earth-based telescopes.

The four other instruments will be:

- The faint object spectrograph which will measure the chemical composition and dynamics of faint light sources, including quasars, comets and galaxies;

- The high-resolution spectrograph which will explore the physical characteristics of exploding galaxies, interstellar gas clouds and jets, and matter escaping from stars.

- The high-speed photometer which will provide precise measurements of light intensity and time variations in the light. It will be important in determining distances;
- The Wide Field Planetary Camera which is expected to record spectacular visual images. It will be capable of providing both high-resolution photographs of planets and sweeping views of galaxies and star fields.

But there are a couple of clouds among the euphoria. Decisions have yet to be made about how the telescope will be repaired and refurbished. It was initially planned to bring it back to Earth every five years for a complete overhaul but costs will probably be prohibitive.

Astronauts from the shuttle will service the telescope but they will not be able to do elaborate work. Another possibility will be to work from the proposed permanent manned space station, but it will not be aloft for at least another eight years and it will not always be close enough in orbit to do emergency repairs.

Another issue is the adverse effect of what is called "shuttle glow", a mysterious background light source that radiates from the surface of spacecraft (*New Scientist*, 12 January, 1984, p 3). Scientists at NASA's Marshall Space Flight Center in Alabama—now believe that the glow will not affect observations in the visible and ultraviolet spectra. But calculations suggest it could affect the infrared instruments that are planned to be added to the telescope five years after launch. □

Japanese seek tape recorder standard

ALL THE MAJOR Japanese electronics companies are now cooperating behind closed doors to fix a standard for a new generation of domestic tape recorders. These will tape sound in digital code, on a very small cassette, and offer several hours of uninterrupted playing time with an audio quality comparable to that of compact discs.

The existing audio cassette was developed by Philips 20 years ago and records only analogue signals. Uninterrupted playing time is under one hour. The Japanese, who 20 years ago were forced to adopt the Philips standard, now believe the time is ripe for a change and a swing to Japanese technology. They hope to have agreement in time for the autumn hi-fi and electronics exhibitions in Japan and West Berlin.

There are two working groups, one looking at digital audio tape recorders with a stationary head (S-DAT), and the other at rotary head machines (R-DAT). Although S-DAT and R-DAT machines will not be compatible, because their technologies are radically different, when the standard is fixed any S-DAT tape will run on any S-DAT machine from any manufacturer and any R-DAT recorder will play any R-DAT tape.

In an S-DAT recorder, narrow tape runs at several centimetres a second past a stationary head. Normally, a stationary head and slow-moving tape could not record the very rapid data stream, of several million bits per second, needed for hi-fi stereo in digital code. So the S-DAT head is sub-divided into many tiny heads, each of which lays down its own very narrow track. JVC has built a prototype head which squeezes 22 separate digital tracks, each only 65 micrometres wide, in an overall width of 1.9 millimetres. The tracks work in parallel, recording different bits of each digital word. By comparison, the stereo tracks of an ordinary audio cassette recorder are each 0.6 millimetres wide.

The R-DAT recorders work on video principles, with a rapidly rotating head drum which obliquely scans a very slowly moving tape. Sony has developed an R-DAT prototype, which can record up to three hours of digital audio on a cassette smaller than an ordinary analogue audio cassette. Although R-DAT technology borrows from video, it is unlikely that there will be any compatibility between audio and video recorders. The makers fear it might confuse the public into trying to play video tapes on an audio machine. □

Sewage transforms barren sandpits to fertile lakes

MUCH OF British glass begins its life at Sandringham in Norfolk, where British Industrial Sands (BIS) has mined sand for more than a century. A side effect of BIS's industry is the creation of great holes in the landscape. Fortunately, the holes are dug to the water table and below; so when the diggers move on to a new site, and the water-extracting pumps are switched off, water fills the hole to form a lake.

Environmentally sound, except for one problem—the lakes are acid and so support only a smattering of organisms that have adapted to the arduous life at low pH. BIS has been trying to remedy this. Together with scientists at the Freshwater Biological Association (FBA) at Windermere, in Cumbria, the firm believes that adding sewage sludge to the sandpits might transform ugly, almost barren, acid lakes into fertile and attractive ones.

The lakes are acid because the sands are rich in iron pyrite. During the mining this mineral is exposed to air and is oxidised to sulphuric acid. The pH of the water in an abandoned pit can be as low as pH 3 (pH 7 is neutral).

Normal lakes are productive to some extent. This means that they are inhabited by plants, primary producers, converting light energy into organic nutrients. As they die and decompose they give rise to a sediment that is rich in organic matter. The most obvious difference between a productive lake and those created by mining sand is that the latter have no organic sediment. The bottom of the lake is sandy, covered in some places with a thin layer of



Blue lagoon: acid killed the surrounding flora

peat topsoil that has been washed in by rain and erosion.

The company contracted William Davison of the FBA to find a way of converting their acid lakes into productive ones. The firm used Davison's protocol in a pilot project on a small lake, called blue lagoon, at a BIS site 8 kilometres west of King's Lynn. With the blessing of the Anglian Water Authority (which has been trying its hardest to keep lakes free of sewage sludge), BIS added 476 700 litres of activated sewage sludge to blue lagoon at the beginning of April last year. Activated sludge is raw sewage that has been partially digested by bacteria. About one month later BIS added 16-98 tonnes of hydrated lime rich in calcium: 15 days after liming, the pH of the lake rose from 3 to 8.

The rise in pH was accompanied by a complete change of flora. Almost magically, algae and other flora typical of rich and productive lakes appeared.

Adding lime to raise the pH would have

worked only temporarily. Sludge, however, provides the lake with a primer for productivity; setting up a system which is self-renewing, an ecosystem. Productivity, together with other parameters such as alkalinity and nutrient status, has remained stable.

Essentially, the oxidation of iron and pyrite, (processes that produce protons and lower the pH) are replaced by the oxidation, principally, of carbon, phosphorous and nitrogen, provided by the sewage sludge. Sulphate and iron are reduced and iron sulphide is precipitated into sediment. Although carbon, phosphorous and nitrogen could

have been added in other forms, they could never be as suitable as sludge. Sewage sludge has three main advantages. First, it most closely mimics the sediment found at the bottoms of natural lakes. It forms a nice, even, homogeneous layer, a natural boundary separating different types of organic processes. Secondly, it provides nutrients in the form most easily accessible to the organisms that thrive at the bottoms of lakes. Finally, it is cheap, free, in fact.

The blue lagoon experiment was a pilot study. Davison believes that the lake is too small for the sludge treatment to provide a lasting transformation. This is partly because it is too shallow to escape the effects of wind. Wind disturbs the sediment, adding oxygen to an otherwise reducing environment and preventing the ecosystem from stabilising. He does believe, however, that the treatment will work for larger lakes. BIS is happy enough with the results from blue lagoon and has begun to reclaim other acid lakes in the area. □

Microprocessors aid on-site analysis of coal

IF THE COAL Board or its customers want to monitor coal quality, samples are sent to laboratories for analysis. But with the development of microprocessors linked to analytic equipment scientists will be able to monitor coal quality on site in either the mine or the power station.

One of the new instruments beams neutrons at coal. The beams stimulate sulphur in the coal to produce gamma rays of a particular frequency. A receiver tuned to this frequency detects the signal, and the micro-processor works out the concentration of sulphur from the intensity of the signal.

Another instrument beams gamma rays through the waste and coal in coal-washing plants. The gamma rays are absorbed by solids, so the proportion of

radiation that is absorbed indicates what the content of solids is. To measure the degree of non inorganic wastes, X-rays are shone from a third instrument, and the degree of absorption by aluminium in the waste is measured. Between them these two techniques show how much coal is thrown away in the washing process, and how

much waste is left in the washed coal.

A fourth instrument measures the quality of the final product. It uses neutron beams to stimulate iron, aluminium, silicon, sulphur and other elements to produce gamma rays. The proportion of the various elements present can be measured by analysing the frequency and intensity of the reflected signal. The instruments are being developed by the Nuclear Applications Centre in Harwell, Britain. BP is funding part of the work. □

Wristwatch monitors radiation

RESEARCHERS at Los Alamos National Laboratory in New Mexico have developed a wristwatch to monitor radiation levels in the workplace. It also tells the time and is worn like an ordinary watch.

The dosimeter in the watch can measure either accumulated radiation dose levels or radiation levels in a particular area. It has four audible alarms. One is triggered by a background radiation count, another sounds when a preset radiation rate has been reached, and a third warns that accumulated radiation exposure has reached a preset limit. The fourth is a "wake up" alarm. □



Neutron beams show the quality of coal

Spring launch for mini video format

SONY will launch its new 8-millimetre video format in Europe this May. Although all the major electronics and photographic companies agreed the technical standards for 8-millimetre video two years ago, and Kodak is trying with limited success to sell a Japanese-made system in the US, no one has yet offered anything for sale in Europe. This is partly because the 12.5-millimetre VHS format has been selling well, and partly because it has proved technically very difficult to make the 8-millimetre format work in Europe.

European TV pictures have 625 lines, at 50 hertz and the video signal on tape must have a wider bandwidth than in the US and Japan where only 525 lines are used, at 60 hertz. Sony has cracked the technical problems, and has the incentive to gamble commercially because its own 12.5-millimetre Beta format is not selling as well as VHS. Sony also says it will start selling Super Beta recorders in the autumn. These rely on a modified version of the standard 12.5-millimetre Beta format and give clearer pictures. But a question mark hangs over Sony's claim that there is compatibility between Super Beta and ordinary Beta.



A question mark also hangs over Sony's chances of commercial success with 8-millimetre video. The first machine, a combined camera and recorder, will cost £1100 which is £100 more than the very similar VHS camcorder already widely on sale.

The 12.5-millimetre tape in existing VHS and Beta recorders runs at around 2 centimetres per second. The 8-millimetre tape in Sony's camcorder runs at either 2 centimetres/second, or 1 centimetre/second, to double recording time. So the video information must be packed much more tightly onto the tape. This is achieved by using tape coated with powdered iron particles instead of metal oxide. The needle-shaped iron particles in the coating are 0.15 micrometres long, compared with nearly 4 micrometres for oxide tape particles. This fine composition lets the tape capture wavelength's down to 0.7 micrometres, which gives twice the resolution of conventional 12.5-millimetre tape. The iron powder tape has a coercivity of 1450 oersted, which is more than twice the coercivity of ordinary oxide video tape. So the 8-millimetre recording heads have a working gap of 0.25 micrometres for creating the flux, which is half the

customary gap size for domestic video recorder heads.

Instead of a conventional TV tube, the camera has a solid state, charge-coupled device sensor with 290 000 individual picture elements. Sound is recorded by the frequency modulation of the carrier, which is mixed in with the video picture signals.

The sophisticated technology in the camcorder, and the high resolution of the tape, shows in the cost. The camcorder costs £1100, and a half hour tape, which runs for one hour at half speed with some loss of picture quality, will cost £7. A double length tape, running for up to two hours, costs only £1 more.

Sony hopes that 8-millimetre video will wean people away from VHS. The company also hopes that it can win more customers for Beta by offering Super Beta, previously promised only for Japan and the US. In a Super Beta recorder the carrier signal for the video information is raised to a higher frequency. In Japan and the US it is raised by 800 kilohertz, in Europe by only 200 kilohertz. The pictures on screen look clearer because more detail can be carried by the higher frequencies.

Super Beta tapes also withstand copying far better than ordinary Beta or VHS tapes do. Even a third generation copy looks clear. But, at the London demonstration, Sony dodged the vital question of compatibility. The company's engineers refused to try playing a Super tape on a standard Beta machine. They admitted that the quality was disappointing. □

Lightweight metal alloy attracts aircraft makers

A CASTING plant in the West Midlands in Britain is creating interest in the aircraft industry. The plant, owned by British Alcan, is the first melting installation for aluminium-lithium alloys. These alloys could reduce the weight of an aircraft by between 15 and 20 per cent if they were used to make airframes.

Although the alloys cost two to three times as much as conventional aluminium frames, this is offset by the reduced fuel costs for a lighter plane. Airbus Industrie is expected to be one of the first companies to buy the alloy for its A320 aircraft, which is still at the design stage.

An aluminium-lithium (Al-Li) alloy was first used in the 1950s by the Soviet Union for its MiG aircraft. When one of these was shot down during the Korean war, western scientists analysed the frame, but found that it had disappointing strength.

However, the Canadian-owned firm, British Alcan, developed a high-strength lithium-aluminium alloy. Another alloy, not so strong, but with good fatigue and fracture performance, is also being developed. The composition of these alloys is aluminium, lithium, copper, magnesium and zinc. The lithium content is about 2.5 per cent.

Apart from their weight-saving, Al-Li alloys have two other significant attractions for aircraft builders. First, their properties are similar to other alloys widely employed by the industry. This means that designers do not have to rethink radically their design



The Airbus A320 may be the first to be built out of aluminium lithium alloys

approach. Secondly, manufacturers do not need to change their existing manufacturing techniques. This is particularly important because manufacturers have invested heavily in numerically controlled machining technology.

The emergence of the aluminium-lithium alloys is also important to the aluminium industry, which has had a large part of the airframe market for a long time. The most serious challenge comes from the development of nonmetallic composites. But, to change to these materials, the aircraft builders would have to invest in new manufacturing techniques.

Engineers at British Alcan's melting plant in the Midlands will soon start to cast 3-tonne ingots. The company hopes to have machine samples of the alloy on its stands at the Paris air show in June. Samples are being sent to aircraft companies in the US, Japan and Europe for evaluation.

Alcoa, a company in the US, has already cast 3-tonne ingots of aluminium-lithium alloy, and is planning to cast ingots weigh-

ing 9 tonnes. The British Alcan plant is unique, however, because it is the only one set up for commercial operation. It cost the company £10 million to build the plant, but Alcoa may soon decide to spend \$50 million on a commercial plant.

Another company turning its attention to Al-Li alloys is the French firm Pechiney, which has already cast ingots of 1.5 tonnes, and will soon start commercial production of 3-tonne ingots. Also, Novamet-Aluminium in the US is producing the alloy, but by a mechanical alloying technique rather than by melting and casting. □

PATENTS **Reading a closed book**

PATENT applications on the British Library's (BL) text digitiser give interesting details of the technology now installed at the Boston Spa lending division and London reference libraries. Patent documents 2 129 642, 2 129 646, and 2 130 042/3/4 explain how the device can read a book, and convert the text and pictures into digital code, without the need to open the pages wide and so risk damaging the binding. The scanner light is low in ultraviolet content, so there is little risk of fading old print.

Conventional photocopyers, and image scanners, require that the book be opened wide and pages spread flat on a glass sheet. This can break its spine.

The BL scanner is in two parts. The lower half is a V-shaped cradle with support plates angled at 80 degrees. Even old and fragile books are not damaged when set in the cradle and opened by such a small angle. The top half of the scanner has a light source with low ultraviolet emission, and a strip of photo-sensitive transistor junctions. The light source and photosensitive strip are pointed at one half of the open book and move on a carriage across its length so that a full page is scanned. The electrical output from the strip is a series of digital pulses which represent whatever is on the page. This signal is recorded magnetically, and subsequently used to reproduce the image accurately on a digitally controlled printer. □

Plastics engine

THE UNITED KINGDOM Atomic Energy Authority (UKAEA) is claiming total monopoly on any internal combustion engine with a block made from "fibre reinforced plastics material". The short patent sketches an engine which is made from plastics, with skins of resin-impregnated carbon fibres wound around anchor pegs to give it strength. All the other engine parts are conventional, and the engine works in a conventional way. The only difference is that it is lighter than a metal one.

Buried in the patent document there is a clue to a very practical problem that the UKAEA may have encountered. The original patent claims were filed in May 1983, but a year later the inventors followed through with a tall-tale plea for amendment. They want now to insert the rider that their plastic engine block must have a cylindrical liner of sufficient strength to

Cinema sound—matching the old with the new

DOLBY Laboratories has been keeping very quiet about its plans for a new kind of multi-channel sound for the cinema. But now European patent 119 101 tells all. Most modern films have a Dolby stereo soundtrack, which gives sound effects from all round the cinema as well as from behind the screen. Epics on 70-millimetre film use six magnetic tracks down the edge of the picture, but most films are on 35-millimetre stock, and use just two optical tracks. Left, centre, right and surround sound is recorded as a mix in a pair of wavering lines which are read by a photo cell.

The snag with these optical tracks is that the sound from the screen can bleed into the speakers round the cinema and vice-versa. Dolby now plans to split two channel optical recordings into four or even six, separate tracks, each in the form of a very thin wavering line to be read by a separate photo cell.

Only a few cinemas will be able to afford suitable replay equipment, so the new prints must be compatible with existing stereo and mono projectors. Dolby has a solution. The tracks will be of different width, with surround tracks narrower than the dialogue tracks. An old fleapit mono projector will read all six tracks at once, but pick up only a little surround sound. A new multi-channel projector will focus its photo cell on the very narrow surround tracks, amplify the sound and route it to speakers around the cinema. □

The mysterious unpublished patent

A MYSTERY surrounds Sir Clive Sinclair's patent cover on the C5 electric tricycle. Sinclair filed a patent application on the C5's electronics in May 1983. Under British patent law this should have been published in the first week of November 1984. Patent searchers could then have read Sir Clive's secrets, two months ahead of his press launch. But the patent application remained unpublished. Although Sir Clive's thunder was partly stolen by leaks about



the C5, the electronics remained secret until the scheduled unveiling. So does Sir Clive have friends in places high enough to bend the patent rules? Or, is the Patent Office now running so inefficiently that it cannot publish as required by law?

The comptroller of the Patent Office is evasive. There is no routine slippage on publication, he says, but it would be a breach of confidence to explain why Sir Clive's patent application never saw the light of day. Other inventors, who often plead for a stay of publication, may now use the curious case of Sinclair's patent application 83/12589 as a useful precedent. □

Fire fighting insulation

FREDERICK Bradley, from Merseyside, in Britain, suggests an interesting idea for providing insulation and fire protection in homes with the same structure. In British patent application (2 136 687), Bradley suggests that thin ceramic shells could be factory-formed with an inert gas, such as nitrogen or



carbon dioxide, encapsulated under pressure. The ceramic shell material and thickness is

**Satellite secrets**

IF THE US military wants to slap a secrecy order on its plan to dangle a low-flying spy satellite from the space shuttle, it will have to unpubish US patent 4 097 010. The latest edition of the British Library's Patent Information Network bulletin points to this document which has been on the library shelves since mid-1978. The patent, filed jointly by Giuseppe Colombo and Mario Grossi, was paid for by the Smithsonian Institution in Washington, and gives full details of the technology.

So far it has proved impossible to hold a satellite in orbit at an altitude lower than about 160 kilometres, because it falls back to Earth and burns up. The patent tells how the new satellite will be tethered to a space shuttle, on the end of a 100 kilometre wire which is paid out from a storage drum aboard the powered craft.

Gravity and atmospheric drag pull out the wire and it is reeled back by motor drive. A shuttle orbiting at 220 kilometres should be able to tether a satellite at 120 kilometres altitude, scanning the Earth below. Data collected by the satellite will be fed back to instruments on the shuttle up a wire inside the tether. □

chosen so that it thrives when heated above normal ambient temperatures. The gas inside then breaks through and quenches any flames in the area.

If the shells are used to line the attic of a building, they will also provide insulation against lost heat. The fragile ceramics are protected by tough outer containers. These are perforated to let through the gas when it escapes from the shell inside. Similar devices could be used to throw at a fire, or dropped from a plane on burning woodlands. □

Barry Fox

Patent information purchase price, contact the London Patent Office and Science Reference Library at 25 Southampton Buildings, London WC2A 1AY (Tel: 01-405 8721).

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To mark its 75th anniversary, the Biochemical Society is sponsoring, in cooperation with *New Scientist*, an essay competition on the theme of 'Biochemistry & Society—Now and in the Future'.

The competition is open to pupils of any secondary school or college of further education in Britain who will be under 19 years of age on 1 January 1986.

First prize is £50 (with books to the value of £200 to the winner's school or college), with two second prizes of £25 each (with books to the value of £50 to the school or college). In addition, the prizewinners will receive a year's subscription to *New Scientist*.

Entries should be typed or written, using only one side of the paper, with your full name and address and date of birth on the first page. Put your name on every sheet. Essays should be about 2000 words, to be received by 7 January 1986. Results will be declared in March 1986, and provided the winning entry is of sufficient merit, it will be published in this journal.

★ ★ ★
Essays should be sent to: Essay Competition, The Biochemical Society, 7 Warwick Court, High Holborn, London WC1R 5DP. (Please enclose an S.A.E. if you wish your essay to be returned.)

A city fit for wildlife

For the first time in its history, London has a strategy for wildlife and the data and resources to implement it. The creation and protection of habitats is becoming part of the planning process

Paul Simons

THERE is a world of natural history in the metropolis of London, and much of it is coming to light thanks to the Greater London Council (GLC). With a team of ecologists and the powers of a strategic planning authority, it is helping to conserve London's wildlife in a number of new projects. Yet the GLC is not merely fighting to keep what wildlife we have; it is actively injecting ecology into planning. The ecology unit of the GLC is helping planners to put ecological knowledge into practice. The aim is to create new habitats within London which will foster a variety of wildlife, by advising architects, river engineers, park managers and the like.

The ecologists now advise on which shrubs will grow on a sea wall, for instance, or what mixtures of seeds are best to create natural habitats for a particular park or golf course. Such practical ecology is also helping authorities to manage existing habitats. The GLC has devised a scheme, for instance, that will restore one of the bogs on Hampstead Heath to its former glory, filled once again with sundews, bog heather and a variety of other plants.

Rational planning also depends upon knowing what wildlife London has already, so that we can judge, for instance, how significant a particular patch threatened with development really is. Hence, the GLC is systematically cataloguing the capital's natural history in a survey which is probably the biggest exercise of its kind in a city anywhere in the world, although not unique (see Box 2). The results are being used for protecting the best wildlife habitats, and educating people in wildlife using some bold innovations.

But what wildlife can possibly survive in the capital? In marshland along the Thames, meadows are still grazed (such as Crayford Marshes at Bexley), and support redshanks and yellow wagtails. Other seminatural habitats include heathland (such as Barnes Common) and ancient woodlands (such as the old Elizabethan hunting forest at Scadbury Park, Bromley). There are already 26 Sites of Special Scientific Interest (SSSIs) notified by the Nature Conservancy Council in Greater London, mostly bits of encapsulated countryside. But there are many more sites yet to be discovered. For example, a remarkable piece of wet meadowland was recently discovered in Hillingdon (*New Scientist*, 6 November 1984, p 5) which supports several notable plants (see Box 1).

Nearer to the heart of London, there is a wealth of overgrown dereliction—disused factories, docks, railway sidings, reservoirs (the Brent Reservoir is so overgrown in places it has developed its own fen), cemeteries, and much more. These are all unintentionally wild places, where colonising plants have paved the way for animals to enter the capital. The Middlesex Filter Beds in Hackney, for example, is a typical abandoned site, where the old filter beds are now full of reeds, and willow woodland has developed by natural colonisation.

Little ringed plovers have nested there, as well as reed warblers; kingfishers and herons are regularly seen. In winter it is visited by gadwall, pintail and teal.

At the centre of town there is more than just the feral pigeon. Kestrels are nesting on city buildings, black redstarts on Westminster Underground station, foxes raising their cubs

on railway embankments, and even bats in the royal parks. In 1982, one voluntary organisation, the London Wildlife Trust, recorded over 2000 sightings of foxes in a public "foxwatch", including many in central London. In the suburbs, there are badgers, deer and hedgehogs. Some 2000 different species of plant have been found growing wild within 30 kilometres of St Paul's Cathedral. In fact, with between 50 and 80 species of birds regularly breeding in any one area, London's suburbs are richer in wildlife than some of the intensively farmed countryside of eastern England.

With so much of the traditional countryside vanishing, the 1600 square kilometres of Greater London are proving a valuable wildlife resource for city people. Interest is growing, and there are now dozens of local groups and voluntary societies in London concerned with preserving its wildlife. They are recording, preserving and educating the public in the ways of urban natural history. But it is a mammoth job, not least because London changes so quickly and there is a daunting public ignorance of everyday wildlife—small wonder that wildlife preservation is a foreign language to so many policymakers based in London.

Planning for ecology

The GLC decided three years ago to bring ecology firmly into planning, so helping to protect the capital's natural history, and to enable the public to appreciate it more fully. The first move was to appoint a team of committed ecologists, headed by David Goode. A specialist in wetland ecology, Goode was formerly deputy chief scientist at the Nature Conservancy Council.

"Wildlife conservation in London is not primarily concerned with the saving of rare and endangered species," says Goode. "It's much more concerned with the value of wildlife to people. There is a tendency for people to regard cities as totally artificial places—yet there are endless opportunities within a city to accommodate wildlife."

One of the GLC's most ambitious projects is the comprehensive survey of wildlife habitats in Greater London's open sites. It is not unique—the West Midlands has a smaller survey under way, and West Berlin pioneered such an inventory some years ago. The whole job is costing the GLC £120 000, but it will provide a long-overdue base line for ecological planning. Carried out under contract by the London Wildlife Trust, which recruited a team of



Derelict—but still home for 12 species of butterfly

DANIEL LUBAN

specialists for the task, the London Wildlife Habitat Survey covers all naturally vegetated areas bigger than half a hectare in inner London, or 1 hectare in the outer boroughs. The type and quality of vegetation is recorded, including 32 categories such as broadleaved native woodland, acid grassland and so on, as well as notable plants, birds, insects and other fauna. Almost 2000 sites will have been catalogued and mapped by the end of the survey this month and the data put on computer. The project was designed by Meg Gaine at the GLC, in conjunction with the council's Computer Section, which helped to develop software to manage the data.

The GLC has funded other surveys by voluntary organisations. The council advertises for grant applications in *Habitat* and other wildlife magazines, although it welcomes approaches from any source. Such projects are coordinated by David Dawson, who has encouraged two surveys by the Fauna and Flora Preservation Society, documenting London's ponds (including a special study of the great crested newt), and making a comprehensive survey of bat colonies. These species are protected under the Wildlife and Countryside Act, but the data needed to ensure their protection are still incomplete.

The information from all the surveys is collected and collated at the GLC. The result is an ecological Domesday Book stored on computer, from which the best wildlife sites



The Middlesex filter beds—a wetland wilderness with fenland vegetation has grown up on the site of an abandoned waterworks



Overgrown—the old cemeteries of London have developed into rich habitats for grasses, flowers and birds

natural history—should have something of the natural world in the place where they live."

These views are gradually becoming accepted. David Hope, a planner in the GLC's ecology team whose job includes commenting on local borough plans, finds that several of the boroughs are now adopting ecological policies recently suggested by the GLC in its proposed alterations to

are drawn for each borough; eventually a wildlife reference book will be published. Such information can be put to a variety of uses: each of London's 32 boroughs can make its own plans for the future of particular sites, using natural history as part of its planning formula in, say, vetting future building applications or road schemes. The response has been enthusiastic, and the data have already been used for advising six boroughs currently making local plans.

Goode goes further. He wants to see every borough in London develop firm policies for ecology and nature conservation in their local plans. This should include at least one statutory local nature reserve in each borough, or else the creation of new habitats in places where there is little wildlife at the moment.

"Then I'd like to see all schools having access to some place at the local level where they can actually do field studies in their own environment, in their own vicinity," says Goode. "And people that live in the most deprived areas—in terms of

1: Survey unearths London's forgotten wildernesses

WHAT has the London Wildlife Habitat Survey revealed? As well as reiterating the presence of valuable captive countryside within the GLC boundary—chalk downs in the south, ancient oak/hornbeam woods in the northeast and river and lake systems in the west, for example—it has brought to light a number of previously unknown wildlife sanctuaries.

The canals of the East End support a wide range of aquatic plants, including five species of duckweed (*Lemna* spp.) and the showier arrowhead (*Sagittaria sagittifolia*) and water plantain (*Alisma plantago-aquatica*). By the towpaths grow old-fashioned weeds such as cornflower (*Centaurea cyanus*) and thorn apple (*Datura stramonium*) as well as more recently arrived aliens such as Sumatran fleabane (*Conyza sumatrensis*) and Mexican tea (*Chenopodium ambrosioides*—see *New Scientist*, 15 November 1984, p.24). In the dockland-redevelopment areas a rich flora and fauna still survives in the

wild waste grounds of the diminishing number of abandoned wharves and demolished warehouses. There are numerous butterflies here (a dozen species on one Royal Docks site), and stonechats, kingfishers and partridges all occur within a few hundred metres of the Blackwall Tunnel.

The most surprising find of all has been an area of meadows by the Yeading Brook in West Hillingdon (*New Scientist*, 6 December 1984, p.5). A forgotten expanse of ancient grassland, replete with such declining species as pepper saxifrage (*Silene silaus*) has survived in the capital when it would probably have been put to cereals or intensive grazing almost anywhere else in the country. The land is owned by Hillingdon council, and unlike the majority of council-owned grassland in Britain it has never been shorn and manicured. Much of it is still cut for hay, and its future as a wildlife haven seems assured in the light of the council's sympathetic response to the London Wildlife Trust's management proposals.

As well as hay meadows, the site contains two small hollows which between them hold a remarkable suite of interesting grassland plants. Grass-leaved vetchling (*Lathyrus missolia*), aders-tongue fern (*Ophioglossum vulgatum*) and sneezewort (*Achillea ptarmica*) occur here with the glaucous sedge (*Carex flacca*) and a few spikes of the spotted orchid (*Dactylorhiza fuchsii*). Most remarkable of all is the presence of several hundred plants of the nationally rare narrow-leaved water dropwort (*Oenanthe silaifolia*). The last time this species was recorded in the historic county of Middlesex (which incorporated what is now Hillingdon) was more than 150 years ago. Then it was reported from Marylebone Fields, where it is unlikely to be rediscovered; that place is now Regent's Park.

The efficiency and success of the London Wildlife Habitat Survey in discovering, recording and mapping such sites is likely to make it a benchmark for future work of its type. □



During and after renovation—a disused coal depot at Camley Street, King's Cross, has been turned into an ecological park

the Greater London Development Plan. Already, boroughs have notified to the Nature Conservancy Council 20 sites that they would like to turn into statutory local nature reserves.

The GLC has also given grants to voluntary natural history and conservation groups totalling nearly £400 000 over the past three years. The money can go towards rent, or a vehicle, or staff, or whatever; the most important thing is that it encourages more wildlife activity. The money is not simply sprayed around—voluntary bodies must show they have competent biologists or practical conservationists. And, for local boroughs, money is being granted for saving sites of wildlife interest. For instance, the celebrated Gunnersbury Triangle—an undisturbed piece of woodland surrounded by railways including the District Line (*New Scientist*, 1 April 1982, p 8)—was bought and preserved by Hounslow borough from British Rail with a GLC grant of £58 000. The GLC also gave expert ecological advice when Hounslow council contested a public inquiry to save the Triangle.

But London's wild land needs more than surveying and protection. Most of it has been shaped in some way by human interference in the past and needs continual management. At Sydenham Hill Wood, 10 hectares of ancient woodland in South London managed by the London Wildlife Trust (LWT), parties of volunteers regularly root out the alien syc-

mores and rhododendrons that grow so fast they usually swamp our native oaks and other woodland flora. Nature trails are also established, a pond has been excavated and scrub cleared to create a better habitat for reptiles and amphibians. Grants from the GLC to the LWT and the British Trust for Conservation Volunteers have helped a massive increase in operations of this kind in the London area. Ironically, though, Sydenham Hill has come under threat from another helping hand—the local borough, Southwark plans to build on a part of the site.

Where there are no valuable sites worth recording, the GLC moves into one of its more imaginative fields. The wildlife survey shows which parts of London are most deprived of natural history, allowing the GLC to direct its resources or anyone else's into creating new places for wildlife. The idea came from the Ecological Parks Trust, which promoted a successful scheme opposite the Tower of London, at the William Curtis Ecological Park. An old lorry park of less than a hectare was turned into a surprisingly natural haven for a wide variety of plants and animals. More than 13 000 people, many of them schoolchildren, now visit the park each year.

Following this success, the GLC launched, its own scheme, in a disused coal depot alongside the Regent's Canal, at Camley Street, near King's Cross. But at £800 000 the dream

2: The world's uneven commitment to urban ecology

IN EUROPE one of the lynchpins to promoting town and city wildlife is Professor Herbert Suckopp. Nowhere is his influence more keenly felt than in West Berlin, his home city, where urban wildlife has a special significance. With his widespread scientific and political contacts, Suckopp has helped establish an extraordinarily detailed survey of inner-city natural history. Using universities (who in turn subcontracted to land designers), every nook and cranny is being examined—roofs, walls, trees, and so on. It is this survey that helped to inspire the urban wildlife surveys in England.

It is also complemented by some very sophisticated technology for controlling pollution. A massive water-treatment plant is being built, to remove sewage and other pollutants at the main inflow to the Tegler See (Lake Tegeler)—an important stretch of water in West Berlin. Additional machinery aerates the water whenever it begins to separate into layers of pollution. Like the GLC, the West Berlin authorities put great effort into publicising urban wildlife conservation, in a series of well-

designed booklets for the layman.

Urban ecology is also popular in Poland, where public opinion (inspired by British protest groups), has prevented a six-lane motorway being built through a forest nature reserve in Warsaw. On the edge of Warsaw, the Polish Academy of Sciences is examining habitats and wildlife on a large housing estate development, in probably the most detailed survey of its kind in the world. They are seeing what effect each part of the development has on wildlife—almost down to the last brick—looking for improvements in these habitats. Using this as a model, they hope to establish precedents for other developments.

On the other hand, the Dutch—are more concerned with creating small *heemparks* (literally, home or natural parks). Occupying only a few hectares, each park recreates the old landscape of woods, hedges, dry and damp meadows, and so on. Great care is taken to select the correct soils and plant species, even if it means collecting these from the other side of the country. Each site is continually managed—the Madestein heempark in the

Hague, for example, employs two full-time managers and several part-time helpers, all paid for by the local authority. Inspired by these heemparks, ecological parks were created in Britain, both in London and elsewhere. Warrington, for instance, has created large tracts of new habitats in the new-town development there. Sweden, too, is following the Dutch example.

In the US, nature conservation is haunted by the large hunting lobby. Gradually, though, public opinion is turning: in the last census, some 40 per cent of the adult population said that they approved of "nonconsumptive uses" of wildlife.

Elsewhere in the world, urban wildlife is considered even less important. Indeed, the nature conservation movement in Britain, and England in particular, is the envy of most other countries. Thanks to the British public's obsession with wild animals, and the countryside in general, planners take a great deal more notice of their opinion. Indeed, Britain is the only country with a statutory obligation to take wildlife into account in planning procedures, such as public inquiries. □



Opposite Tower Bridge—the William Curtis Ecological Park

of creating wildlife bliss in slumland did not come cheap. So what was achieved for all this money? The site, just under a hectare, was scheduled to become a coach park when the GLC stepped in and bought it for £600 000. For a further £120 000 it then renovated and landscaped the site from scratch in cooperation with the LWT (which now runs it), Camden Council and local residents. The GLC's landscape designers produced a pond, reedbeds, marshland, a small meadow, and fringing woodland, together with a study centre. A warden now manages the whole park, and even though Camley Street Natural Park does not officially open until May, the response to the project has been very encouraging. The Inner London Education Authority has appointed a full-time teacher to supervise the hundreds of schoolchildren who are expected.

The GLC argues that it is good value for money for both enjoyment and education. Certainly one could argue that museums provide a similar—but more expensive—function. At another extreme, we all know that wildlife protected by the Wildlife and Countryside Act does not always come cheap. Or compare the costs with parks. The initial cost of landscaping orthodox open spaces in central London could be £100 000 per acre (0.4 hectares), compared with £60 000 per acre for Camley Street. The upkeep could also be cheaper in a well designed nature park, because the fertility of the soil is low and less management is needed than in a town park with all its mown grass.

"It's alright having parks but you also need something else," says Goode. "Parks can be very sterile as far as wildlife is concerned. If it's all mown grass and a few standard trees, then there will be a very limited number of birds. If you have a much more diverse assemblage of plants with greater [habitat] diversity, it will support much more interesting wildlife. Take Holland Park, for instance. It's got a very much

greater mixture of habitats—it's not what you'd regard as an ordinary park, yet the people of Kensington actually love it. They enjoy all the birds that you see there. Because it is in fact a piece of woodland right in the midst of West London—and I think this is a good illustration of what can be done."

The GLC is pleased with Camley Street, and plans further forays into wildlife construction. The ecology team includes Jane Smart, whose job is to advise on creating these new wildlife sites, from wildflower meadows in school grounds, to attracting wildlife to factory grounds, such as the Ford works at Dagenham. Meanwhile, the GLC is planning another controversial asset—Ecology Centres in the middle of London at Covent Garden and King's Cross (both due to open officially this year). The centres will cater for public exhibitions and meetings, but also provide a home for a wide range of conservation and ecology groups, run by a new independent trust, and with the GLC's Community Liaison Ecologist, Jacklyn Chandler, seeing the scheme through. The investment is large, but the GLC hopes that several voluntary organisations under one roof will together have a stronger voice, and be better organised for undertaking future surveys, or conserving areas of interest. And the GLC feels that the sort of publicity that the centres will provide for ecology and conservation in the heart of London can only do good for the future of the metropolis.

More and more people are interested in upgrading the urban environment, but such developments require strategic planning that takes the broad view. If the GLC goes, none of the 33 boroughs in London will have the manpower or expertise to inject ecological thinking into planning. Nor would it be cost effective for each borough to hire its own ecologist. The voluntary organisations that have done so much to map the wildlife of London would also be left high and dry. Without the GLC, says David Goode, "there is little hope of this new ecological awareness being maintained". □

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Programming the first generation

The influx of computers into schools in the past few years has been of enormous proportions. But when they leave school, what skills will our children possess?

John Lamb

FIVE years ago, few children leaving school had ever laid hands on a computer. Today there is a microcomputer for every 100 children in secondary school. But the popular picture of young fingers deftly manipulating the new technology to fashion computer programs, of eager faces flushed with excitement of interacting with educational software, is a false image. Teachers and their charges are finding their new classmates can be a bit of a handful.

Computers have flooded into our schools as a result of a government policy intended to produce a workforce better versed in information technology and, incidentally, to give the British computer industry a leg up. Between 1980 and the end of 1984, more than £36 million of government money had been spent on computers, software and teacher instruction in England and Wales.

Conceived by the Callaghan government, initially shelved by the present administration and then resurrected by Margaret Thatcher, the programme has put 120 000 microcomputers into primary and secondary schools. Grants from the Department of Trade and Industry helped schools to buy 37 000 of them.

Urged on by ministers keen to instil new skills in the country's future workforce, and by what some teachers call "computer-anxious parents" concerned about their offsprings' job prospects, schools have had to come to terms with their new equipment. How are they making out?

To begin with, there is some way to go before all children in secondary schools have a fair crack at the computer. The BBC's Educational Broadcasting Services Research Unit* surveyed 432 schools last year. Only 30 were able to give more than three-quarters of their senior pupils a "go" on a microcomputer. Younger children were more likely to have encountered a computer, because many older children had opted to study subjects which made little use of computers. In the 11-12 age range, almost one quarter of the schools that took part in the BBC survey had managed to give the majority of these children experience of computers. At this age, children are more likely to attend computer

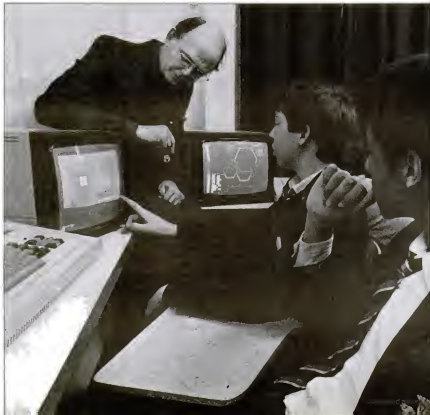


Can British children learn from computers?

awareness classes and to be enthusiastic about computers, which they may already have encountered in their primary schools.

Mathematics, science, geography and computer studies make most use of computers, according to the BBC's research, and some schools have attempted to curb the enthusiasm of these departments by imposing limits on their computer time. But, as Robert Dixon points out in a recent article on the use of computers in mathematics teaching (*New Scientist*, 14 March 1985, p 12), there has been a great deal of interest among teachers in using the graphics ability of microcomputers in this subject. The same applies to other subjects in which a computer can be a valuable aid to putting across what children regard as abstractions. Arts subjects seem to have less need of computers because they deal with more concrete parts of life.

Some head teachers, backed by enthusiastic parent-teacher association and go-ahead local education authorities, have amassed as many as 40 machines, enough to give each child in a class their own keyboard and screen. Less well-off schools, or those run by heads wary of electronic gadgets,



make do with a minimum of computers, and there are still a few secondary schools with no microcomputers at all. In general, schools in prosperous parts of the country are ahead of those in poorer regions. The BBC survey reports a continuing demand for computer hardware: 85 per cent of schools the BBC surveyed plan to buy more computers over the next two years—if they can find the money. Government schemes for primary and secondary schools are now over, and schools must depend for supplies of hardware on local education authorities and the fund-raising efforts of parents. So far, British companies—Acorn, Research Machines and Sinclair—have provided most of the computers for use in schools. Now it seems that American firms such as Apple, Commodore and Atari are hoping to muscle in. Apple has recently launched an aggressive cut-price promotion for schools with the slogan "our kids can't wait". Education has long been regarded as an important market for hardware manufacturers who want to "get 'em young".

The ability to program is the most obvious skill that a child might acquire from school computing, but it is not necessarily an instant passport to a job. Although surveys of the computer industry continually allege that there is a severe shortage of programmers, systems analysts and engineers, school-leavers often find it difficult to get a start in computing. Employers want skilled staff and are reluctant to spend money on trainees.

In any case, few school children will join the sunrise industries of computing and electronics. Even if they do work with computers, they will not need more than an acquaintance with the standard typewriter keyboard in order to cope with the technology. In the longer term, detailed knowledge of computers will become even less relevant as manufacturers strive to cut out the complexities of computer operation and make their machines more "user friendly".

The original emphasis on the vocational training aspect of schools computing was misplaced: the real struggle is to introduce computers as aids to teaching across the whole curriculum. That will require better software, more computers and teachers who believe in the educational value of the technology.

Other high-technology teaching aids such as cable television, language laborato-

ries, videocassette recorders and even mainframe computer terminals have had their day in schools. Few of those innovations were introduced in quite the same fashion as microcomputers. Apart from a hard core already involved in computer studies and aware of the technology, teachers were largely ignorant about computer-aided schooling until the packing cases containing their systems began to arrive.

Before the hardware could be put to work, teachers had to be trained to use it. Over 100 000 teachers from primary and secondary schools, about one-quarter of all teachers, have now attended courses run under the Microelectronics Education Programme. The Department of Education and Science (DES) set up this scheme to promote the use of computers and electronic devices in schools. When the Department of Trade and Industry made its offer to supply schools with microcomputers at half price, it laid down a condition that every school supplied should send at least two teachers on these courses.

The basic two- to four-day courses, however, can do little more than introduce the teachers to the equipment and sketch out some of the principles of computing. Much more study is required before teachers are conversant with their systems.

"Some teachers think 'computers are too complicated for me. I shall be shown up in front of the class,'" says Donovan Tagg of the University of Lancaster, a pioneer of educational computing. "This has already been the experience of many teachers in schools where computers were introduced early. I am not convinced that all computer designers have yet taken this point seriously. If I am not using my own simple computer, I feel nervous when undertaking a demonstration."

Other teachers have embraced the technology wholeheartedly. The BBC survey emphasises the wide variation between schools in the use of and attitude to computers. The enthusiasm of some schools is apparent in the number of programs that individual teachers, as opposed to commercial or state-sponsored software producers, have produced. Like their pupils, teachers also get bitten by the computer bug. They have produced some 4000 software packages, many of them for sale. As in the commercial application of computers, there is a tendency among teacher programmers to duplicate work done by others either because they are not aware of earlier efforts, or because they believe they can do better.

Many teachers, whether they program or not, have been quick to appreciate the value of computers as a teaching aid. Their speed in retrieving information and manipulating numbers takes much of the drudgery out of these tasks. ▶



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► Colour graphics and devices like voice synthesisers, light pens and robots enhance the computer's message, while its ability to respond immediately to a child also makes it a powerful medium for teaching. Unlike books or films, computer programs can be changed to suit individual teaching styles, although there are few programs which allow the average teacher to do this.

The popularity of video games has led to the development of educational games. They range from versions of the "hangman" word game to programs like *Newton*, which simulates the flight path of a satellite. There is even one game called *GB Ltd* which simulates the role of the prime minister. Games are thought to motivate children to learn, although Tag points out that children quickly become adept at licking the sugar off the learning pill.

Simulation programs are particularly useful in science subjects because they can reproduce experiments that would be impossible to conduct in school laboratories. But school microcomputers are limited, and many simulation programs lack the speed and memory needed to produce accurate models of what goes on in the real world.

What can children learn?

Game playing and simulation demand little active participation from children, but information retrieval programs are a different matter. These programs are databases or repositories for data collected by children. "It is in the handling of data that children can best develop an understanding of what counts for knowledge", says Bill O'Neill of the University of Ulster. "They can be led into the areas of critical interpretation. As the computer takes over the role of storing and sorting the data, children can increasingly involve themselves in analysing the significance of the data."

The BBC's Domesday project, which involves 9000 schools, is one example of how information retrieval programs are used. The project is an attempt to produce an up-to-date version of the original Domesday book. Schools will collect and store information about their local communities on their own micros and then forward their findings to a central team. Eventually the data will be transferred to a videodisc, to mark the 900th anniversary of the original census in 1086.

The Microelectronics Education Programme stresses the need for programs to be creative. Primary schools are using word-processing programs, smaller versions of those used by adults, to help young children to learn to write. The advantage of the TV screen and keyboard over pen and paper is that they give children greater freedom. Because they do not have to worry about crossings out, children can learn to structure their writing in a way that is impossible on paper.

But "computer-anxious" parents want their children to learn how to write programs, not just school essays. And it is in this area that educational computing has scored one of its biggest successes: with the language LOGO. Developed by Seymour Papert at the Massachusetts Institute of Technology, LOGO is a computer language for children which enables them to explore their own ideas. With LOGO, children teach a computer about their world rather than the other way round. LOGO originally used small mechanical drawing devices called turtles which are directed by typing in instructions through a keyboard. But more complex programs have also been written using the language. For example, a LOGO program called Animal has been developed in which children build up a database of animals and their attributes. The program mirrors the learning process of a child, making mistakes, waiting for instruction from its operator and so on.

LOGO has to some extent supplanted BASIC, in which most microcomputer programs are written, as the standard beginners language. BASIC has been constantly criticised for its slowness, quirky variable names and open procedures, which make it difficult to produce or modify long programs. BASIC's

shortcomings have also prompted computer manufacturers to devise their own versions of the language, resulting in Sinclair BASIC, for example, which is incompatible with BASIC on the BBC microcomputer or any other BASIC for that matter. BASIC is so entrenched now that it would be almost impossible to standardise it.

Software is a controversial issue in schools computing. "Nobody can fail to be impressed by the hardworking dedication and missionary fervour of those involved in educational computing today. However, I have come to feel that much of this effort is misplaced," writes John Self of the University of Lancaster in his book *Microcomputers in Education*.

Self and others argue that producing educationally useful programs is a complex task which cannot be left to "improvised hackery which flies in the face of standard educational psychology and software design principles". Self points to "bug"-ridden programs with poor instruction manuals; even those that are well presented, he says, can confuse both teachers and taught.

At the heart of many criticisms of educational computing is a debate within the teaching profession about the value of rote learning and the drill and practice approach to teaching: what one researcher describes as "building up mental muscles". During the 1970s, experiments in computer-aided learning were carried out in the US and to a lesser extent in Britain. Here, the National Development Programme in Computer Assisted Learning (NDPCAL) was set up in 1973 to explore the potential of computers in the classroom. Relying on terminals connected to mainframe computers in polytechnics or universities, NDPCAL developed a number of programs for use in schools. After just four years, the project closed. It folded partly because computer-assisted learning was just not economic in this country, but also because researchers had become disillusioned with the idea of programmed learning.

A classic computer-assisted learning program will break a topic down into a series of small steps. At the end of each step, the computer presents a pupil with a problem to which there is only one correct answer. Get the answer right and you move on to the next step, make a mistake and you go through that step again. This approach to teaching is based on the ideas of the American psychologist B. F. Skinner, who saw reinforcement as an important part of the learning process.

The problem with the Skinnerian approach is that children tend to learn without understanding the implications of what they learn. There is little scope for creative thinking, or for working on problems for which there is no single right answer. In addition, the rigid computer program cannot cater for a style of learning in which a sudden insight may make sense of what a learner had previously not been able to grasp.

All these drawbacks discredited computer-assisted learning. Some research even showed that children exposed to computerised teaching fell behind those taught by more conventional methods. Research into the performance of computer-assisted learning is, however, complicated by the reluctance of educationalists to use children as guinea pigs.

Some teachers worry that the lessons learnt during the 1960s and 1970s are not being applied by those developing the microcomputers of the 1980s. In a survey of 29 programs designed for primary schools, Bill O'Neill, of the University of Ulster, found that 15 were of the rote learning type. "A great deal of research since [the 1960s] has criticised this approach, not only on the grounds of its simplistic concept of human learning, but also of the assumption that skills learnt in isolation will transfer to real situations," says O'Neill.

Teachers seem undeterred by such warnings. The BBC's survey found that computer-assisted learning was near the top of the list of software that schools wanted more of. □

* Microcomputers in Secondary Schools: a survey of England, Wales and Northern Ireland secondary schools. BBC Educational Services Research Unit, Room 308, Villiers House, Havers Green, London W5 2PA.

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The Micrarium occupies the old Pump Room at Buxton. The key to its appeal lies in a unique system of projection microscopes

Through a glass clearly

At Buxton's Micrarium, visitors can explore the world beneath the microscope without having to squint down badly illuminated tubes

Tony Jones

CONFERENCES come to Buxton, and then they go, leaving the town with its home-grown attractions. One of these is the Micrarium, an imaginative experiment in "hands-on" science. Inside the Micrarium, visitors step into the world beneath the microscope, and explore it at their leisure. The idea is simple, but the effect is startling. And it is the only Micrarium in the world.

Buxton is a spa town in Derbyshire, nestling among the western hills of the Peak District. Some say it is the highest town in England. Indeed, it sits on the thousand-foot contour, which obligingly winds its way among the hotels, gardens and warm baths of what the Romans called *Aquae Arnemetiae*. The town's fame as a tourist resort is built upon the reputed health-giving qualities of the warm springs that bubble up from the limestone layers beneath it. Perhaps it is a sign of the quaint, slightly Victorian flavour of the place that an official guide commends the water as being "highly radioactive".

The Micrarium's director, Stephen Carter, has been a devotee of microscopy since childhood. He qualified in medicine, and spent several years studying tropical pathology in

West Africa before joining ICI's Pharmaceutical Division in Cheshire. After 20 years of research into cancer drugs, he retired to devote his time to sharing his love of microscopy with the public. The result is the Micrarium, which Carter runs as a family business with his wife, Janet, and daughter, Stephanie. It is funded by their personal savings, Carter's retirement payment, and the takings at the door. The key to the Micrarium, and what makes it unique, is the projection microscope.

Carter is scathing about the "brass and glass" mentality that sees microscopes as ornaments to be ensconced in glass cabinets and on sideboards, to be polished and purred over, but never used as they were intended. He is particularly incensed by the unimaginative attitude of museums, which might typically put a conventional microscope beneath a glass cover, without proper lighting, and invite people to rub their noses in the greasy patch left by previous visitors.

The Micrarium is open daily, 10 am to 5 pm, from the end of March to the first week in November. Admission £1.20 (OAP's 80p, children 60p).



To solve this problem, Carter set out to design a microscope that would throw a large image on to a screen—no more squinting down narrow tubes. It had to be reliable, cheap and public-proof. Moreover, it had to be simple enough for the family to mass-produce at home. "The crucial element in invention and design is simplifying, simplifying and simplifying," says Carter. "If I could spend half a day eliminating one screw-hole then it was worthwhile. We finished up with something which was just about as simple as I could make it."

Over two years, Carter, and his wife and three daughters, made 50 microscopes in their garage workshop, involving more than 40 000 separate parts, half of them home-made. Yet, at that stage, they still did not know where their project would find a home.

The Micrium sits opposite the 18th-century splendour of Buxton's Crescent, in what was once the Pump Room and latterly the Tourist Information Centre. Locals still grieve the loss of their Pump Room, endowing it with more mystic potency in its eclipse than it had in its heyday. In deference to their feelings, Carter has constructed the Micrium on a free-standing timber framework within the walls, leaving the Victorian fabric of the building unscathed. At first glance, the dim interior is surprisingly small. But then, so are its contents.

You do not see the microscopes. They are tucked away overhead, behind the elegant wooden panelling. In each one, a 100-watt lamp directs light down on to a large, angled screen at waist level. Lenses giving magnifications of 50, 90 or 170 click in and out of the beam. A carousel carries up to eight conventional specimen slides and rotates them into the beam one by one. You can select a slide, change magnification, focus the picture and move it about, all by simple remote controls and without fear of damaging anything. The projected images are big, bright and clear. The illusion of looking through a window into a new world is almost perfect.

What is there to see? From the outset, Carter was determined that the Micrium would present exhibits from throughout the natural world. At the beginning, he relied on commercially produced slides, few of which were really suitable. "The tradition was to mount one flea with its legs beautifully splayed, dead in the middle of the slide, and everything absolutely perfect. We want things to be in context, and things to be actually happening. As an example, I have got a part of the paper comb from a fully developed wasps' nest. You can see the eggs, the larvae, the pupae and the emerging wasps, actually frozen in time. Now this is the sort of thing I think is right for the general public. Not a single specimen, but a story."

Some of the most appealing displays are of live creatures. A baby newt scampers about on the screen, shoals of red blood cells pulsing through its gills. Snail embryos take shape inside their eggs—a shell here, a foot there. A complete ants' nest lives and grows before you. You can watch scuttling beetles, writhing worms and acrobatic blobs whose imposing names are out of all proportion to their tiny bodies.

Being unique causes problems

A great deal of ingenuity has gone into some of the slides. Take the snowflake. Captured two winters ago, it remains preserved in a polymerised resin for all to see. Or the brilliantly coloured crystals which melt and reform anew at the touch of a button. These novel techniques are part of the growing expertise that the family has built up over the past few years, and which is now arguably its greatest asset.

After three years, the Buxton Micrium is still unique. And being unique is a problem. No one who comes to the Micrium for the first time knows quite what to expect. Carter thinks many visitors to Buxton give the Micrium a miss simply because they are wary of spending money on something unfamiliar. Some people even seem contemptuous of it, perhaps with unpleasant memories of fairground "freak" shows. Potential visitors often shy away at the door, muttering scornfully about "bugs". Is it the association of microscopes with laboratories and white coats, "microbes", germs and disease that puts them off?

Carter's mission is not helped by the recent capture of the prefix "micro" by the burgeoning jargon of computer-speak. "I counted something like 22 magazines on a magazine rack, dealing with computers. What is particularly maddening is that they are called things like *Micro*, *Micro User* and *Micro Choice*. The word 'micro' does not mean 'computer', and it irritates me enormously. People have come here expecting to see computers because we call ourselves a Micrium."

Those who do venture into the Micrium are rarely disappointed. People now come from great distances because they have heard about the Micrium, and are anxious to see it for themselves. Once they have seen it they are hooked. As Carter says, "Our problem has been to persuade a highly suspicious and sceptical public to enter the Micrium. At the end of the day, the problem has been to persuade them to come out again."

Dr Tony Jones works at the Nuffield Radio Astronomy Laboratories, Jodrell Bank.

Microscopy is anything but a "dead" subject. Exhibits at the Micrium include, for instance, a live ants' nest. Bottom left: Steven Carter, the director, discusses the finer points of a ladybird's head with a young visitor

FORUM

Will Britain scatter its European allies?

Tom Wilkie fears that experiments with neutrons will go the way of research into particle physics

ONE of the apparent paradoxes of modern physics is that the smaller the object you wish to examine, the larger (and hence more expensive) the experimental apparatus you have to use. To study the elementary particles requires the biggest machines of all. To probe the structure of matter at the atomic and molecular level, on the other hand, we can use neutron scattering experiments.

Neutron sources are smaller, and less expensive, than giant accelerators, such as those of CERN, the European laboratory for particle physics. But, in this field of science too, European countries have tried to meet the high cost of research by pooling their resources and setting up an international laboratory.

Together with France and West Germany, Britain participates in research at the Institut Laue-Langevin (ILL) at Grenoble, France. Recently, however, scientists have started up a new British facility for such research—the Spallation Neutron Source (SNS), at the Science and Engineering Research Council's (SERC) Rutherford Appleton Laboratory near Oxford.

For a variety of reasons, the scattering of thermal neutrons has established itself as a uniquely powerful probe of the structure of, and atomic motions in, condensed matter (see "How neutrons probe matter with matter", *New Scientist*, 21 January 1985, p 26). Physicists, material scientists, chemists and biologists have all found neutron scattering an essential and irreplaceable tool for understanding new materials and new systems.

Superficially, the contrast between the state of the particle-physics community and the neutron scatterers could not be sharper. The whole future of experimental particle physics hangs in the balance. The SERC is so strapped for funds that it is having difficulties in paying Britain's subscription to CERN, and a SERC committee will soon advise on whether Britain should pull out of CERN altogether and spend the money saved on other areas of science. On the other hand, now that the Spallation Neutron Source has started up, the neutron scatterers have access to the facilities at both Grenoble and Oxford.

Beneath the surface, however, the situation is rather different. Although nothing like as expensive as CERN, the Institut Laue-Langevin costs the SERC about £6 million a year; were it fully operational, the Spallation Neutron Source would cost about £11 million. But, because it is so short of money, the SERC is providing only about two-thirds of the funds that would be required to make full use of the SNS. There is money to instrument only about one-

third of the beam-lines at present, and to pay the electricity bills for only six months of the year. There is no logic in spending

Complementary sources: the Spallation Neutron Source (below) and the reactor at the Institut Laue-Langevin (right)



two-thirds of the funds to get only one-sixth of the science.

The SERC might be tempted to find the money to "top up" the SNS's funds by reducing its contribution to the Grenoble institute. But, in a similar way, relatively small cuts in the subscription to the ILL would result in a proportionately much larger cut in the instruments available or the operating schedule of the reactor. Furthermore, if Britain reduced its contribution to ILL, France and West Germany might also reduce their support.

Researchers in British universities have already suffered cutbacks in the number of experimental facilities available for neutron scattering. Since the 1960s, they had access to neutron beam-lines from two research reactors at the UKAEA's research establishment at Harwell. In 1975/6, when the SNS was first planned, it was to be an additional experimental facility. However, once its funds were committed to the SNS, the SERC was unable to maintain the neutron-scattering programme at Harwell, which ceased a year ago.

This story has an odd parallel with the history of elementary particle physics. Over the years, the SERC shut down the experimental facilities available in Britain, and forced experimenters to concentrate their efforts at one laboratory—CERN in Geneva. Now, having put all its eggs in one basket, the SERC is saying that it cannot carry the burden. Consequently, Britain's programme of experiments in particle physics may come to a complete stop.

But if the SERC reduced its subscription to, or even pulled out of, the

Institut Laue-Langevin, should Britain's neutron scatterers worry? After all, Britain now has the SNS.

By common consent, the Institut Laue-Langevin is, and is likely to remain, the best and most productive neutron-scattering facility in the world. The Spallation Neutron Source is in no sense a replacement for the ILL: the two sources of neutrons are complementary, not competitive.

The source of neutrons at the ILL is the High Flux nuclear reactor, which produces continuous beams of neutrons. The Spallation Neutron Source uses a particle accelerator to "chip" or "spall" neutrons out of the nucleus of a uranium target. It produces neutrons in pulses, not continuously. When it operates at full power, it will produce a pulse of neutrons, a few tens of microseconds long, every 1/50th of a second.

The intensity of neutrons in the short pulses produced by the SNS—the brightness of the source—differs from that at the ILL. For high-energy neutrons, the SNS is the brighter source; at intermediate energies, it is similar; but at low energies, the ILL source is brighter. Similarly, the total number of neutrons the SNS sends down each beam-line per second (the time-averaged flux) is orders of magnitude smaller than at the ILL for all but the highest energy neutrons.

By their nature, pulsed sources are best suited to experiments that need a high instantaneous brightness and use neutrons with a wide range of energies. They are particularly apt for studies of powders, liquids, and amorphous materials. On the other hand, high-resolution studies (of, for example, the structure and dynamics of crystals, and the fluctuations associated with phase transitions) generally need a high time-averaged flux, so it is best to use a reactor-source of neutrons. The SNS and the source at the ILL are therefore used for quite different experiments.

In Britain, we are fortunate: we do not have to choose between the two kinds of sources, as both are available now. But what if the SERC continues to be short of money and we do have to make a choice?

In the US, the Seitz Committee has recently addressed this dilemma and advised that the US should choose a

reactor, because the committee sees experiments using low-energy neutrons, and high resolution studies, as being particularly important. Meanwhile, German scientists are proposing that they should build a spallation source in the 1990s. But the German machine would have a very much longer pulse than the SNS, to produce a time-averaged flux similar to that at the ILL. This would enable the scientists to perform the lower energy, high resolution experiments, with the additional benefits of a pulsed source. In both cases, the primary scientific needs are perceived to be high

brightness at low neutron energies and high time-averaged flux at all energies.

For the foreseeable future, then, it is scientifically essential for Britain to maintain, as its highest priority, full funding of the ILL—the world's best continuous neutron source. Participation at the ILL is vital to the continuation of a wide range of British science, and to withdraw, or even reduce funding of it, would be a disaster. Beyond that, it is simply wasteful not to find the relatively small amount of additional money needed to make full use of the SNS. □

The hidden cost of star wars

Could killer satellites zap US industry? Dan Greenberg thinks they might



LTV Corporation/Mesa, Lanza

The man of the new frontier. Shouldn't he come down to Earth?

that the US is far and away the world leader in R&D, and can surely afford the billions sought for star wars. The US does, indeed, spend more on R&D than Japan and Western Europe combined. But a few numbers soon dispel any comfort that might be derived from that position.

The fact is that the US government

spends 70 per cent of its R&D budget on military programmes; Japan spends less than 3 per cent on military research, and West Germany less than 10 per cent. These countries put the rest of their money into making the products that sell so well in the US.

Star wars enthusiasts counter that US industry spends much of its own money on research, even more than the \$60 thousand million that the federal government is budgeting for R&D next year. But again, detailed figures on research spending leave little room for complacency.

According to "International Science and Technology Update", a report from the National Science Foundation, the US spends 8 per cent of the money from industry on, say, automotive R&D; Japan puts over 16 per cent of its money into automotive research, and spending there has been going up, while in the US it has been going down. The West German car industry also puts more of its money into research, and figures for the chemical industries are equally unflattering.

Is the system of R&D in the US so big and flexible that it can accommodate star wars and still maintain vigour in the civilian sector? No one knows, but the signs of strain are evident in electronics and computers, which are central to military prowess and industrial competition.

On top of that, high salaries in industry have made it difficult for engineering schools to recruit staff, to the extent that deans must look abroad for teachers. The staffing problem, which is self-perpetuating, is bound to get worse as money pours into star wars.

Debate in the US has so far focused on the strategic aspects of the programme. It should now turn to whether it can afford it, not in dollars, but in the scarce talent that it will divert from the business of earning the country its living. □

AFTER the partisans have exhausted themselves over whether star wars will or won't work, and whether the Soviets should welcome or fear it, an important neglected issue should be examined: pursuit of this colossal high-tech gamble may cannibalise the research enterprise that underpins industrial competitiveness in the US.

Bear with some obscure and elastic numbers. But, as their implications become clearer, they may well have more effect on the fate of star wars than the strategic and political considerations that now dominate public debate of the programme proposed by Mr Reagan.

The long-term research costs of star wars are unknowable at present, because the decisions about this unprecedented defensive design have yet to be made. But, with the US planning to spend \$3.7 thousand million on the programme next year, and a total of \$30 thousand million by 1990, the Administration is committing to star wars much of the nation's scientific and technical expertise.

According to a study by the Council on Economic Priorities, a policy research institute in New York, star wars will absorb nearly one-third of the country's R&D expansion next year. Over the next five years, the council estimates, star wars will absorb half the growth in defence R&D, which already dominates the US government's spending on science and engineering.

Supporters of the programme will argue

Of devilish devices and trivial pursuits

Good news for Brainstorms, from Bernard Dixon

FIVE YEARS after the unhappy demise of Roy Herbert's splendid magazine *Antique Machines and Curiosities*, there must be countless folk who are still suffering chronic withdrawal symptoms. For, like *Picture Post*, *World Medicine* and *Argosy*, this was a magazine which left a tremendous gap. I shall long recall *AM + C* (as fanatics called it) for its rapidly established reputation as a peerless source of Amazing Facts. Time Utilizer, I discovered from its pages, was the trademark of an early make of sewing machine. And the reason Count Rumford invented the infusing coffee pot, I learnt one month, was because he was trying to reform the drunken citizens of Munich.

Among other cullings: "a sacrificator" was a spring-operated, razor-sharp bleeding instrument, carrying up to 10 blades, which doctors of an earlier age wielded to slice into their patients' arms and legs. Domestic appliances were developed mainly in the US, because there was no servant class or tradition of service there. And, in 1896, the British Post Office introduced a telephone in which the mouthpiece was surrounded

by something resembling a horse-collar. The idea was that you pushed your face into it when you wanted to make a private call in a public place. It was taken out of service several years later because of the risk of spreading infection.

Fun, charming headlines ("Interesting discovery by photographer"...) "Machine shows how balls change") and more than a hint of amateurish eccentricity characterised *AM + C*. With input from chaps of the calibre of witty wordsmith Herbert, and a doubly distinguished Fleet Street science editor who to this day keeps his booze in poison bottles, it had pace and dash. But an editorial board headed by Dame Margaret Weston, director of the Science Museum, ensured that it was also serious, even scholarly.

Someone, sometime, will surely grasp the same literary niche again, fill it with a magazine of similar enticement, and arrange far better promotion and distribution than did the publishers of *AM + C*. Meanwhile, I have news for those devotees who are still craving a similarly satisfying source. They should contact the Scientific

ANTIQUE MACHINES curiosities



ing chunks of iron in 40 seconds, and vitrifying mortar in 527 Or that naturalist Georges Buffon constructed a device that could set fire to wood 65 metres away—thereby demonstrating that Archimedes' feat at Syracuse was possible, whatever the sceptics may say?

The span of Darius's journal can be gauged from other items in this single issue. They include a review of national inven-

know about the use of lenses and mirrors to concentrate solar heat. Did you realise, for instance, that during the 17th century Villeta, a Frenchman, built a massive burning glass capable of piercing brass counters in six seconds, melting chunks of iron in 40 seconds, and vitrifying mortar in 527 Or that naturalist Georges Buffon constructed a device that could set fire to wood 65 metres away—thereby demonstrating that Archimedes' feat at Syracuse was possible, whatever the sceptics may say?

tories of instruments; correspondence on quadrants and astrolabes; queries about Blunt instruments (made by the Blunt family) and the history of Oertling balances; and an account of the difficulties experienced, and solutions found, when taking photographs of objects like an aneroid barometer with a curved glass face.

I am sure that Darius would be delighted to hear from other people keen to join his band of enthusiasts. He can be contacted at the Science Museum, in London. I trust, however, that readers of his bulletin were not involved in another event reported in that recent issue: the theft of sextants, compasses, sundials and other precious objects, from the Monte Mario Observatory in Italy last year. This, it appears, was no fortuitous crime, but a robbery "commissioned", and carried out, by experts.

Blasting off this mortal coil

Christopher Joyce on how to go out with a bang

AM + C and (top) the GPO's answer to eavesdroppers

Instrument Society, and ask for a sample copy of its bulletin.

This—be warned at once—is a very different journal from Herbert's. Matt rather than glossy, slim instead of fat, less wide-ranging, and containing papers with references and footnotes rather than journalistically written articles, it is of more sober mien. But the material it carries is fascinating, and may well please the many gadget fanatics whose need for a parish magazine has gone unfulfilled.

The Scientific Instrument Society came into being two years ago, to bring together people interested in scientific instruments in many shapes and forms, from precious antiques, through the brass knobs and wooden boxes of Victoriana, to early electronic devices only recently out of production. Among the members of this (for the moment London-orientated) fraternity are both amateur enthusiasts and professional people working in museums and the antiques trade.

Despite its different format, the society's organ has several points of contact with *AM + C*. There is a link with the Science Museum, in the form of the editor, Jon Darius—the museum's Keeper of Astronomy, and the man responsible for the marvellous collection of historic scientific photographs published in *Beyond Vision* (OUP) last year (*New Scientist*, 17 May 1984, p 50). The readers are closely involved, too, as evidenced by the classified advertisement columns ("Lodestone wanted... size immaterial") and a regular feature in which experts identify mystery objects. There is even a hint of eccentricity, in the vague announcement that the bulletin is published "several times a year".

In a recent issue (*Bulletin of the Scientific Instrument Society*, no 4) was a review of burning glasses. Although this began by rubbishing the old story that Archimedes focused the sun's rays to destroy the Roman fleet under Marcellus ("the truthfulness of this popular incident is open to serious question"), the author, P. E. Spargo, told me much I never realised I wanted to

THERE IS a lot of man-made stuff orbiting the Earth. Satellites, mostly, helping us to make telephone calls, spying on missile tests, watching the weather, that sort of thing. Soon, we are told, enterprising Americans will be manufacturing drugs, crystals, silicon chips and the like in orbiting factories. This great leap upward is what spaceniks in Washington, including chief space cadet Ronald Reagan, proudly declare the "commercialisation of space".

If, indeed, it is humanity's destiny to reap profits from a vacuum, businesses have been disappointingly slow to realise it. So it warmed my heart to hear that the US government had approved one of the first attempts to turn a buck in space.

The region of the Van Allen belt, we are told, is a jolly place for a graveyard. At least, that is what The Celestis Group, a company in Florida, believes. It plans to encapsulate human ashes and blast them into near-perpetual (63 million years) orbit above the Earth.

The company will hire a private launch service, Space Services Inc, of Texas, to carry as many as 10 330 ash-filled containers, each about the size of a thumb, in a single satellite. It claims its secret process can squeeze a dear departed's ashes into just one of these capsules.

Ever mindful that funerals are as much for the living as the dead, Celestis is considering having the 300-pound satellite painted with a highly reflective material. On clear evenings, then, friends and relatives will be able to gather round the home telescope and observe the orbiting dead. Granted, the price, \$3900 per berth, is steep, but burial plots here on Earth aren't cheap either. And think how much you can save on flowers.

There are few moments in the history of marketing that shine with such genius. Celestis's courage will, I hope, embolden those budding entrepreneurs who have held back, despite the President's promises of a gold rush in space. In the tradition of US spaceploitation (remember the astronauts who took stamps into orbit, hoping to sell

them on return?), perhaps we can look forward to:

Stellar Adverts: Sell your shampoo/mouthwash/roll-on deodorant on Laser-Lite (TM), 300 kilometres by 250 kilometres at 57 degrees inclination, geosynchronous orbit. At only \$10 000 per hour, it leaves neon in the dark.

Jupiter Junk-It: Got three generations of family memorabilia gathering dust in the attic? Then send it to us. Our team of expert junkers will pack it, haul it and blast it. No fuss, no muss, just trust it to us.

Elba Orbits: Completed your *coup d'état*? What do you do with the opposition? When it's time to say "adios" to those worn-out politicians, send them to us. Discreet, confidential service. Special rate for juntas.

Fly-O-Genies Inc: As the nuclear holocaust looms, why risk frying in some dank shelter? Instead, secure your future with us—2000 miles up! Watch the fireworks from the best seat in the house.

Clearly, a civilisation that created fast-food drive-ins, roller discos and *Dallas* can find myriad ways to make a profit in space. When the great minds of American marketing start a cookin', the sky's the limit.



The final journey, then and now

For 'mass prevention' read 'mass con'

James Le Fanu rubs salt in the medical establishment's wounds

ARGUMENTS between scientists in public can be as illuminating as they are frequently entertaining. They show science to be less about facts than their interpretation, and scientists, in their interpretations, more partisan than objective. Dissension humanises science.

The row among doctors about the relationship between salt in the diet and hypertension (raised blood pressure) is a case in point. The debate is of general interest, as it touches on recommendations that everyone should change their traditional dietary habits if they want to stay healthy.

The evidence linking dietary salt with raised blood pressure was recently reviewed by John Emsley (*New Scientist*, 6 December 1984, p 28). There is vast variation in salt intakes across the world, and this variation appears to correlate with the incidence of hypertension and strokes. Experiments on rats and humans have shown that drastic reductions in salt intake will lower blood pressure in those who already have hypertension.

Now, hypertension is common in the West, and we consume, at 10 grams per day, about three times as much salt as we need. Enter the theory of "mass prevention". If everyone reduced their salt intake, the argument goes, everyone's blood pressure would fall. This would be as good as reducing the number of strokes as the standard medical practice of trying to identify the few with severe hypertension and treating them with salt-reduced diets or drugs.

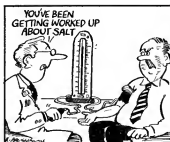
This reasoning has persuaded no fewer than three expert committees in as many years to recommend that everyone reduce their salt intake. The WHO (1982) and NACNE (1983) reports said we should halve our salt intake (by adding no salt to food and cutting down on salted commodities), while the DHSS's COMA report (1984) suggested that steps should be taken to consider reducing it. Similar recommendations have been made by several committees in the US.

Some, however, may have noticed a certain imaginative leap in these reports. They presuppose that recommendations to reduce salt intake will reduce blood pressure, and that, were it to do so, this would reduce the risk of having a stroke in those with normal or slightly raised blood pressures. Both suppositions are dubious; neither has been tested. In fact, most strokes occur in those with mild hypertension or normal blood pressure.

What can be the motives of the health educators who present supposition as fact, and require people to change the habits of a lifetime on pain of suffering a stroke? The answer, it seems, lies in a heated exchange in the correspondence pages of *The Lancet*.

The row was sparked off by a letter from not just one expert disagreeing with the party line, but 13, and from eight different centres (*Lancet*, 1984, vol ii, p 436). They were concerned that, on salt intake, "The

usual scientific standards for weighing evidence and giving advice seem to have been forgotten in an evangelical crusade to present a simplistic view of the evidence that will prove attractive to the media." Extrapolation from a limited number of



positive studies involving small numbers of hypertensive patients to give lifelong advice on dietary modification to the general population was "unjustified and irresponsible", they said. In short, no one had done the work to justify the recommendations, and properly conducted studies were needed.

Reasonable enough, one would have thought. It scarcely merited what followed. The ensuing correspondence was (with one exception) hostile. It consisted of five main

arguments. First, that present levels of salt intake are harmful because everyone says they are: "The consensus is that salt intake is already substantially in excess of requirements... That it may contribute to prevalent cardiovascular mortality is as widely agreed as any proposition in medicine is likely to be." Secondly, that our fondness for salt is a harmful addiction: "The promiscuous addition of salt is a bizarre, recent custom, without any apparent justification other than gustatory pleasure." Or, "The comparison with alcohol and tobacco is even more pertinent. All three are natural substances which are harmful when they become addictive."

The third argument was that the value of cutting down on salt is not amenable to scientific testing, the fourth that scientists should not break ranks when it comes to telling people what is good for them, and the fifth simply reaffirmed the circumstantial data implicating salt in hypertension.

So, for three years, the public has been told that for the good of its health it is imperative that it reduces its salt intake. Professors have professed it, reports have reiterated it, television has taunted people with it. Newspapers have been full of little else. And many people, as a straw poll at a dinner party will testify, have taken it to heart. Yet, as *The Lancet's* correspondence demonstrates, when the protagonists are winked out of their committee rooms to justify their position, we get affirmative rhetoric, emotional imagery, calls to solidarity. Everything, in short, except rationality. It is as if a religious belief had been challenged. □

From Ponting to the cuts

Why parliament should clear the air



EVER since this column started some 18 years ago, I have eschewed comment on my own political campaigns. I cannot, however, resist reflection on the new guidelines that Sir Robert Armstrong, head of the civil service, has issued on the

duties of civil servants in relation to ministers. They seem to have been issued in haste, as a direct result of the acquittal of Clive Ponting.

Armstrong writes, in his note to permanent secretaries: "Civil servants are servants of the Crown. For all practical purposes, the Crown in this context means the government of the day. The civil servant as such has no constitutional personality, or responsibility separate from the duly elected government of the day."

He goes on to tell us that civil servants should not be required to do anything unlawful. "Such a matter should be reported to the principal establishments officer." He vouchsafes that, when giving evidence to select committees of the House of Commons, the responsibility lies with

ministers, and not with civil servants, to decide on what, and how much, information should be made available. Should a civil servant find himself or herself opposed to a particular course of action, he or she, Armstrong tells us, should consult a superior officer. If reporting to a senior officer did not resolve the matter, the civil servant could always resign from the service.

A fat lot of use that would have been in the case of Clive Ponting, say I, having sat, day after day, in court number 2 during his trial at the Old Bailey.

The mind boggles at what would have happened to Ponting had he knocked on the door of Sir Clive Whitmore, his permanent secretary boss and, in a previous incarnation, Mrs Thatcher's principal private secretary, or that of the Cabinet Secretary, in relation to the touchy subject of the Belgrano. Were they going to take on the Prime Minister on this bag of nails? Not in a month of Sundays. Moreover, Armstrong himself states, "even after resignation, he or she (the civil servant) will be bound to keep the confidences to which he or she has become privy as a civil servant".

Armstrong's guidance misses the whole point of the unanimous verdict of the Old Bailey jury, and what my colleagues of all parties, some publicly, and most others



privately, say is the overriding supremacy of parliament. In his guidelines, he skates over the position of civil servants being asked to mislead parliament—still less does he cast any pearls before us swine about the wording of the Official Secrets Act.

The Official Secrets Act clearly states that it is not an offence to communicate information to an "authorised person", or to a person to whom communication "is in the interests of the state". I deem it to be in the interests of the state that I should be told the truth about unclassified information, so long as I have the privilege of representing my fellow electors. The jury acquitted Ponting of breaking the Official Secrets Act, and it therefore rejected the argument on which it had been explicitly asked to rule; namely, whether the interests of the state were identical to those of the government of the day.

If I have dwelt at length on this topic, it is partly because, in my view, it has direct relevance for those in the civil service, or in scientific establishments, who wish to speak out against the fearsome cuts in Britain's science budget. These are certainly not "in the interests of the state". □

ENIGMA

No 301

Adding letters

by Eric Emmet

BELOW IS an addition sum with letters substituted for digits. The same letter stands for the same digit wherever it appears, and different letters stand for different digits.

A H K G A E E D

G E E R R E E D

P R E H B B E D

B R M P B K E D

Write out the sum with numbers substituted for letters.

A £10 book token will be awarded to the sender of the first correct solution opened on Thursday, 11 April, 1985. Please send entries to Enigma No 301, *New Scientist*, Commonwealth House, 1-19 New Oxford Street, London WC1A 1NG. The Editor's decision is final. The winner of *Enigma* No 298, "Suspended Sentences", was J. P. Papanicolaou, of London.

Answer to Enigma 298

Suspended sentences

Stan's sentence "... 1 is 4, 2 is 3, 3 is 2, 4 is 2, 5 is 1, 6 is 1, 7 is 1". (Will's sentence must have had eight 1s.)

FEEDBACK'S award for sheer cheek goes to one of the few ex-members of *New Scientist*'s staff to have gone on to an even less exalted career. We refer, of course, to the Right Honourable Timothy Raison MP, minister for overseas development (*New Scientist* staff, 1956-61).

Raison was speaking last week at a conference the International Institute for Environment and Development organised in London on the future development of Africa. Raison did his best to explain, to a largely hostile audience, what Britain's shrinking aid budget is contributing to the continent.

"I must at least refer to the Tropical Development and Research Institute, one of the scientific units of the ODA," Raison said, going on to mention some of the highly regarded work the unit carries out. "We have spent a great deal of money since 1979, through the TDRI..."

Raison did not, of course, mention that the government created the TDRI in 1982 by merging two former, and larger, institutes—a move roundly condemned by a commonsense select committee. □

WHAT PEOPLE will do to avoid taking the blame. For example, Telecom Gold, Britain's electronic mail system, has some fans in this office. But they aren't too keen on how it apologises for mistakes.

When Telecom Gold wants to blow its trumpet about a new facility or service, it invites users to read "Telecom Gold Automated Office News". But when something goes wrong, T. Gold spreads news under the title "ITT Dialcom Automated Office News". Now T. Gold may be only the licensee for Dialcom, but it can hardly blame ITT for the power failures and telephone problems that seem to inflict the service a bit too often. □

THIS COLUMN would like to thank, humbly, J. Watson, A. P. Piercy, B. J. B. Thompson, P. D. Caton, R. C. Tucker and P. L. G. Bateman and others who have all written to tell us that Atomic Strip ("Banish draughts forever") lives up to its claims. Well, for 15 years, anyway.

A correspondent from Swansea, enclosing a roll of the strip, assures us that "It is widely used to seal potholes in small boats down here, where the nuclear fishin' can be somewhat hazardous." We're not quite sure what he means.

On a similar note, Feedback was intrigued to discover that the citizens of Debre Zeit, Ethiopia, enjoy the services of an Atomic Laundry. No doubt the government, which has ratified the Non Proliferation Treaty, is keeping its eye on developments. □

EVER had a computer "throw a wobbler" on you? Just about everyone who has sat before a VDU screen has tales to tell. Most of us put it down to software written by an idiot, manuals written by chimpanzees (or, worse, by a computer) or common or garden stupidity on the part of the brain before the keyboard.

The Association for the Study of Anomalous Phenomena has other ideas. Could it be "the ghost in the machine"? □

FEEDBACK

The Association is seeking information "at first or second hand, no matter how bizarre, concerning inexplicable malfunction or unexpected output". At least, that's what it says in a letter to *Practical Computing*.

Don't send us details of the ghosts in your machine, send them to Roger Morgan, 15a Kensington Court Gardens, London W8 5QF. All accounts, he says, will be treated in confidence. Are people ashamed of owning up to such phenomena? □

FEEDBACK was first to break the news of the correlation between the value of the dollar and the incidence of AIDS. Now a correspondent, after looking at the map of heart deaths in England and Wales (31 January, p 7) points out that "the link between deaths from heart disease and the outcrop of the British coal-bearing rocks is too good to ignore". In mining areas, there is an obvious link, but what about in places such as North Wales? □

FOREIGN businessmen who build factories in Ireland take a little while to get used to local customs. A pin-striped British manager called at a village general store and asked for a copy of *The Times*.

"Will that be the *Irish Times* or the *London Times*?" asked the shop-keeper. "I'll make that the *Irish Times*," the Brit said gallantly.

"Will that be today's *Irish Times* or yesterday's *Irish Times*?"

"Today's, of course."

"Well for that, you'll have to come back tomorrow." □

IN FAIRNESS, the Irish find the British equally puzzling. One of our reporters visited an Irish factory recently, and was quizzed by a high-powered but bewildered businessman about the existence of a society that builds ramps to help hedgehogs cross cattle grids. He had to admit that the society exists; at least one of *New Scientist*'s staff is related to a member. Her membership number is 209 001, which suggests a large following.

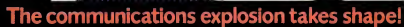
We don't totally believe the figure, but the society's latest newsletter is a gem. It reports on a Worcester man who was seen jumping up and down on a hedgehog. His defence to the magistrates was that he thought the hedgehog had attacked his dog. In another incident, a task force from the charity stopped a fortune-teller roasting hedgehogs at a charity fair.

Another item tells of four Shropshire hedgehogs which have been exported to the island of Sark. They travelled by road, rail, sea and air, and en route had a night in a posh London hotel. Two more went to the Scilly Isles by helicopter.

But the society has a sense of humour. One member sent in £1 and asked for advice on whether ordinary artists' modelling clay would be suitable for cooking hedgehogs before deep-freezing them for winter feasts. The society is soon to be registered as a charity, so people will be able to leave money to *Eriacus europaeus* and its relatives.

Hedgehog fans should write to: British Hedgehog Preservation Society, Knowbury House, Knowbury, Ludlow, Shropshire. □

QL NEWS



Read on and discover exciting new ways to use your QL... with the QL modem... telephony unit... and powerful interface options.



DAVID KARLIN

Why Q COM is everything you could wish for in communications.

The QL is now communicating – via Q COM! This exciting three-part peripheral presents QL users with a multitude of ways to exploit the world of communications.

Once connected to the QL, Q COM allows you to access the considerable number of phone-in databases, such as Prestel and QNet.

Q COM enables you to communicate with other computer users. Its facilities include electronic mail, data transfer from Microdrives and bulletin boards.

Through it you can link your QL to larger minicomputers. Q COM has full capability in this area, and allows the QL to talk to powerful mainframes.

Q COM's automatic dialling

and call acceptance facilities, together with the storage of messages from other modems, will revolutionise the way you use your telephone.

The next few pages of QL News tell you much more.

It's enough for me to say here that with the QL and Q COM,

you'll be exploring new openings in communications for some time to come!

David Karlin

David Karlin,
Chief Design Engineer.



The Q COM package

Three special parts to stack!



QL communications interface

This multi-speed interface contains the sophisticated software used to set up QL communications – and to control the Q CALL and Q MOD units.

Q CON also comes complete with Microdrive-based software. This enables the QL to link to larger computers using VT100 and viewdata protocols. The software will also run any standard modem – connected via Q CON's built-in RS-232-C port.

Most importantly, Q CON allows the QL to transmit and

receive at rates switchable from 75 to 9600 baud (encompassing the widely-used 75/1200 Prestel rates, and 1200/1200 half duplex rates for user-to-user exchange).

Q CON is specially styled to suit your QL – with similar fluting and ribs – and forms the base module of a vertical-stacking system.

It's supplied with full instructions, software on Microdrive cartridge, and connecting leads.



QL auto dial/answer unit

Q CALL gives every QL user something out of the ordinary.

It's a module which links directly to your telephone, and allows auto-dialling at the push of a single key. In the same way, it will permit incoming calls to be

accepted automatically... and even trigger pre-programmed activity from the QL!

Q CALL is the central unit of the package. It plugs directly into Q CON – so there are no connecting cables to worry about.



QL modem

Q MOD has all the powerful facilities expected of a modem, in a neat and simple unit.

It uses either V23 75/1200 or 1200/1200 baud rates, for Prestel, Micronet 800 and all the

viewdata services described alongside.

It also incorporates a telephone extension socket for manual dialling.

Q MOD is the top unit of



Q COM, and comes with a 9' built-in telephone cable.

The QL hooked on voice and data

The QL can now act as your personal address book and telephone operator!

Q COM allows you to store hundreds of personal or business numbers.

You can store lengthy passwords and account numbers – and recall them – at the touch of a single key.

And any information that's sent to you from other modems can be gathered and stored on Microdrive cartridge, or incorporated into your QL Quill documents!



Exploring the world of QNet, Prestel, Micronet and more!

Thousands of QL users already enjoy the excitement of linking to a nationwide mainframe.

Q COM turns your QL into an intelligent terminal, allowing you to access many thousands of pages of information, software and communications facilities.

The services brought to you through Prestel can include Micronet 800, Viewfax 258 and QNet, the new QL database.

Membership of QNet will bring you free software, QL news and features, and all the wide-ranging services of viewdata!

If armchair shopping is more

your style, that's easy too. It's often possible to place a direct order using your QL. For dedicated QL owners, there's a daily selection of software reviews, chart toppers... and all the facts and figures you need to make buying peripherals simple.

With Q COM you can also 'download' software from the system directly into your QL and either use it immediately, or store it on Microdrive cartridge.

In fact the only problem you'll face with a viewdata service is finding enough time to explore its many features!

You can find out how to join QNet by phoning 01-278 3143.



News... information... banking services and QNet. And only a fraction of the QL's new viewdata capability.

QL meets the mainframes!

The Q CON unit of Q COM turns your QL into a VT100 terminal, providing instant access to in-house computing services, both mainframe and mini.

Whether you are using your QL at home or at work, Q COM gives you access to electronic bulletin boards which provide help and advice 24 hours a day. You can leave messages or notices for friends or business contacts and even hold live discussions with them.

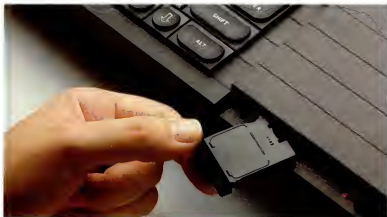
Additional benefits for the QL business user include easy access of in-house company software, and the interrogation of other data bases around the country.

There's also the opportunity of linking to British Telecom Gold – the widely-publicised and popular messaging service.

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QL Hardware

Microdrive cartridge price cut to only £1.99!



Sinclair Microdrive cartridges – up to 100K of programs and data on a medium so compact you can pop it into your pocket.

On February 1, the cost of Microdrive cartridges came down from £4.95 to £1.99 each.

Microdrive cartridges are the QL's own unique storage medium. Each stores up to 100K of information (that's 40 pages of A4 text), on a cartridge no bigger than a book of matches!

Over 500,000 cartridges are now being used throughout Britain.

You can store up to 50 different data files per cartridge, identified by titles of your own choice.

And QL Microdrives themselves are standard equipment on the new ICL One Per Desk micro, and British Telecom's new Merlin Tonto.

IEEE-488... the instrument connection

IEEE-488 is the interface standard set by the Institute of Electronic and Electrical Engineers for instrumentation control.

IEEE-488 – or General Purpose Instrumentation Bus – is a parallel interface specifically designed for high speed data transfer between a number of

different types of device.

It is commonly used for controlling instrumentation via a computer, allowing the creation of laboratory data acquisition systems, industrial control schemes, etc.

The QL now has a fully-fledged IEEE-488 interface from CST. It plugs neatly into the QL's RAM expansion port, and can control up to 16 instruments simultaneously.

It's available from CST on (0223) 323302.

New inte 3 1/2" or 5 1/4"

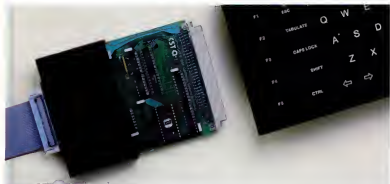
With new Q-Disk, you can transform the QL into a powerful small business system – comprising QL, monitor, disk interface, twin disk drives and printer.

Q-Disk upgrades the QL to disk storage. Fitting easily into the QL's left hand RAM expansion port, without the need for a special expansion box, it contains a Western Digital disk controller chip. Software is held in an on-board EPROM (so little of the QL's RAM is used).

Plug in Q-Disk, and the QL accepts one or two disk drives, sized 3 in, 3 1/2 in, 5 1/4 in, either 40 or 80 track, single or double-sided. Even when two drives are used, they can be different types!

Q-Disk offers up to 1.6 Mbytes of quick, reliable storage with a compatible disk drive.

It's made by Computamate, who also offer a full range of



An IEEE-488 interface slips discreetly into place.



QL to link students

Strathclyde University, in Glasgow, plans to have a campus network of 7000 QLs linked to a central VAX minicomputer.

That's one QL for every student... a major investment project in a university which is now a leading centre for artificial intelligence work.

Sindair is giving support worth £250,000 to the project. And it's likely that QL users

everywhere will benefit - the students plan to develop AI programs to run on the QL.

The QL has impressed Prof. James Alty of the University's Computer Science Department, who says 'only the QL could offer the computing power, range of applications, and above all the portability, at a realistic price.'

ace to connect 3" disk drives

complimentary QL disk drives.

To contact Computamate, phone (0782) 811711.



Single disk unit fitted with 5 1/4 inch drives and (inset) the QL-Disk controller.

The QL's high-tech spec

Dimensions

138 x 46 x 472mm
(5 1/4" x 1 1/2" x 18 3/4")

Weight

1388 gms (3.055 lbs)

RAM

Massive 128K standard RAM, externally expandable to 640K. Extra RAM is available in 64K, 128K, 256K and 512K units, from third-party suppliers.

ROM

48K, containing Sinclair SuperBASIC and the Sinclair Qdos operating system.

CPU

Motorola 68008 (running at 7.5 MHz) for all principal functions. (Architecturally, the 68008 is a 32-bit processor with an eight-bit data bus. One megabyte of non-segmented address space is available.)

In addition, an Intel 8049 controls the keyboard, generates the sound, and acts as an RS-232-C receiver.

Operating system

Qdos (developed by Sinclair Research) is a single-user multi-tasking, time-sliced system using Sinclair SuperBASIC as a command language with display handling for multiple screen windows; and device-independent input-output.

Language

Sinclair SuperBASIC, with the advantages of procedure structuring; extensibility (including syntax); interpretation speed independent of program size; clean machine code interface; operating system facilities accessible from SuperBASIC; equal capability for strings and arrays; and full error-handling facilities.

Microdrives

The QL incorporates twin QL Microdrives, each with a minimum 100K capacity, 3.5 seconds average access time. Typical loading rate of machine code programs is 2-3K per second.

Video

High resolution graphics capability with colour or monochrome monitor (or TV) in two modes - 512 x 256 pixels (four

colours available) and 256 x 256 pixels (eight colours available). Normal character display format of up to 85 x 25 with choice of character sets available (TV format of up to 40 to 60 columns depending on the software).

Keyboard

Full-size, 65-key QWERTY keyboard featuring a space bar, left- and right-hand shift keys, five function keys and four cursor control keys. The keyboard can be angled by means of detachable feet.

Expansion

Excluding RGB monitor, power socket and TV port, eight peripheral/expansion ports are provided - one internal expansion, one Microdrive expansion, one ROM cartridge, two serial and two control channels, and the local area network.

Serial

Two standard RS-232-C communications interfaces for printers, modems, etc. Transmission at rates from 75-19200 baud or full duplex transmit/receive at seven rates up to 9600 baud.

LAN

For up to 64 QL computers. Data transmission over the net can be achieved at 100K baud.

Power supply

9VDC at 1.8A, 15.6VAC at 0.2A.

Joysticks

Provision for one or two devices for games or cursor control.

Applications Software

QL Quill - word processor
QL Abacus - spreadsheet
QL Easel - graphics
QL Archive - database
All four packages supplied with the QL.

Price

£399 including VAT, QL programs, full A4 manual, power supply, 4 blank cartridges and free Helpline service.

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QL Software

Updated versions of Psion software now available!

QL Abacus, Archive, Easel and Quill are the four Psion programs supplied with every QL. They're now converted to 100% machine code, and as a result they load from Microdrive cart-ridge much faster.

The overlays present in Version One software have been removed, resulting in noticeably quicker on-screen performance.

With the compactness of machine code, there's a big saving in QL memory too – all four programs now cope with larger, more professional applications!

Version Two software is now supplied with every new QL. Existing QLUB members – see back page.

QL-Quill

QL Quill makes it easy to type in, correct and store your letters, memos and reports.

No training is needed – a beginner can be using QL Quill for word-processing within minutes!

QL Quill has the facilities of professional word processing packages: including word wrap, search and replace, justification, page headers and footers.



QL-Abacus

QL Abacus is a powerful, yet easy-to-use spreadsheet.

The program allows you to manipulate the contents of whole rows and columns by the names you assign them. There's no need to depend on confusing letters and numbers.

QL Abacus also incorporates a range of functions which let you carry out rapid 'what if' analyses on your data.

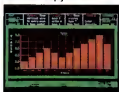


QL-Easel

QL Easel allows you to create graphs, bar charts and pie charts – at the touch of a key.

The program handles anything from lines and shaded curves to overlapping or stacked bars.

QL Easel designs and scales automatically or under your control. Text can be added and altered as simply as data.



QL-Archive

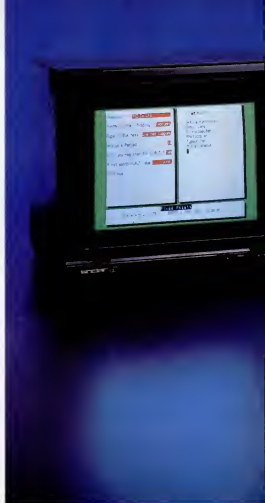
QL Archive is a sophisticated, powerful database program.

It includes a screen editor which allows you to design your own screen and format your reports, and a procedure editor which lets you tailor QL Archive to your own requirements.

QL Archive is ideal for all database uses, yet it's powerful enough to be used by many software houses to generate specific database applications.



Non-members of QLUB can purchase new versions of the above software for £15 per title, or £50 for all four programs. Phone (0276) 686100 for details.



(Left to right) QL-Entrepreneur, QL-Project Planner and QL-Decision Maker from Sinclair

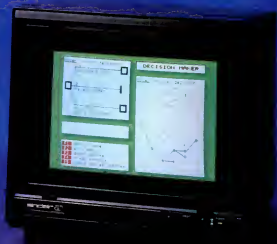
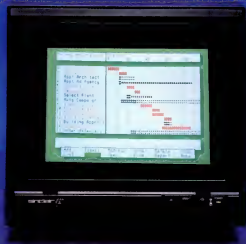
Coming soon- QL-Entrepreneur, QL-Project Planner, QL-Decision Maker!

Three new QL business programs – with a difference!

QL-Entrepreneur, QL-Project Planner and QL-Decision Maker train you to apply new and exciting management skills – through original and powerful means!

An interactive teaching program gives you a thorough and enjoyable understanding of each subject – backed by a textbook and 'self-test' facilities – and an applications program helps you to use your new expertise for specific problems and projects.

All three titles will increase your understanding and extend your control – making involved subjects easy, stimulating and useful!



QL-Entrepreneur

QL-Entrepreneur is an essential program for anyone preparing to start a new business – whatever it may be!

It uses a 'question and answer' format to help you build a workable business plan.

With the input you give, it works out the break-even point of the business; the first 18 months' cash flow, the type of finance needed; the year end Balance Sheet and Profit and Loss accounts... and more!

QL-Entrepreneur builds your skills and techniques.

It's flexible too, so that you can ask complex 'what if' questions at any stage!

The program comes with a third, blank Microdrive cart-

ridge and a comprehensive A5 manual.

QL-Project Planner

QL-Project Planner will produce plans you can understand, monitor and more easily achieve.

First, you break the project down into its individual activities, telling QL-Project Planner how long each takes and which are inter-dependent.

When you decide on a starting time/date QL-Project Planner will tell you when each activity must start and finish and when the project will be completed.

Each activity is divided into its critically important stages – those which can safely be moved around without altering

the time taken by the project and those where movement will affect the completion deadline.

Whether or not you've used project planning systems before, you'll be amazed at the difference QL-Project Planner can make.

The program comes with a third, blank Microdrive cartridge and a comprehensive A5 manual.

QL-Decision Maker

Whether you're thinking of buying a house, or taking on a new business contract, QL-Decision Maker makes the choices clearer!

It lets you look at the possibilities – and their implications – through a decision tree.

Once you've set out the decisions and their probable costs or results, QL-Decision Maker shows the outcomes which would occur from each particular route.

You can see how much money a decision could make for you... or cost you. Complex 'what if' questions are dealt with swiftly and graphically.

You can depend on the QL to highlight the best possible route!

QL-Decision Maker comes with a third, blank Microdrive cartridge and a comprehensive A5 manual.

All three programs are available from Sinclair stockists, price £39.95 each, or Sinclair Research. Tel: (0276) 686100.

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Now, buy a QL and you're a member of the QLAB-free!

QLUB is the special Users Bureau for Sinclair QL owners.

Already, there are well over 10,000 QLAB members... enjoying a whole range of information and advisory services.

Until now, joining QLAB cost £35 per year. From March 4, every new QL

owner can become a member - free of charge!

With your new QL, you'll find a post-paid form. Complete and mail it, and you'll soon be a member of the fastest growing computer club in the country.

And you'll enjoy all the helpful services listed here!

What QLAB membership offers you

Regular newsletters delivered to your door

One of the most important QLAB benefits is the special news magazine, appearing six

times a year. The magazine provides a forum for QL owners to exchange views and keep in

touch with all the latest developments.

Each issue is packed with updates on QL hardware and software, tips on applying the four QL programs, and news of how other people are using the QL.



Special discounts

QLUB members also receive a range of special discounts, with savings of at least 20% on selected software products.

There are also special subscription rates for Personal Computer News and QL User.

Free Helpline service from Psion

All QLAB members are entitled to 12 months special assistance from Psion.

They're at the end of the telephone to answer any questions on using the QL Abacus, Archive, Easel and Quill programs supplied with the computer.

Help is also available on any aspect of using Sinclair SuperBASIC, Qdos, or linking your QL with major peripherals.

Psion will normally answer any queries within 48 hours.

QL program updates are no longer available free to QLAB members. They will be sold separately.

Good news for existing QLAB members too!

As one of the first members of QLAB, you should already have received one free update of each of the four QL programs - and a letter with your new membership details.

If for any reason you haven't, you should ring (0276) 686100.

You're a QL owner, but not a QLAB member?

Then joining QLAB is easy and free! Ring (0276) 685311 for full details. You can be a full QLAB member within a few days.

Where to find the QL

The Sinclair QL is available at selected branches of Dixons, WH Smith, John Lewis Partnership, Currys, Greens in Debenhams and Ultimate, and larger branches of Boots, John Menzies and specialist computer stores nationwide.

Sinclair, QL, QLAB, Qdos, and SuperBASIC are Trade Marks of Sinclair Research Ltd. Quill, Easel, Archive and Abacus are Trade Marks of Psion Ltd.

Sinclair Research Ltd
Camberley, Surrey, GU15 3BR.
Tel: Camberley (0276) 686100.

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REVIEW

Big prizes bring bigger rewards

WHEN Alfred Nobel, the inventor of dynamite, died in 1896 he left a will which surprised almost everyone. Members of his family received only 1 million crowns out of an estate estimated at more than 30 million crowns; and none was named as executor to the estate. Most of the money was to be invested in safe securities, and the interest was to be distributed in the form of annual prizes "to those who, during the preceding year, shall have conferred the greatest benefit on mankind". As almost everyone now knows, five prizes were created: in physics, chemistry, physiology or medicine, literature and peace.

The prize system in science was not new; it had played an important role in rewarding and encouraging scientific work since at least the 18th century. What Nobel proposed, however, was something on a totally different scale. Some \$270 000 was available for the annual prizes. With each prize worth about \$54 000, the laureates stood to gain about 30 times the annual salary of a university

**The Beginnings of the Nobel Institution:
The Science Prizes, 1901-1915**
by Elizabeth Crawford, Cambridge UP, pp 281, £22.50

Robin Clarke

professor. Small wonder that those who were charged with setting up the institutions to administer the prize money had a hard time; or that bitter wrangles developed among those likely to receive a prize and those whose job it was to allocate the glory.

Elizabeth Crawford writes of these things with skill and much scholarship. She spent five years researching and writing this book. Her analysis is minute, and the wealth of detail she has managed to unearth concerning the state of science, and its institutions, in Scandinavia at the turn of the century is quite remarkable. She writes knowledgeably of the prizes, medals and grants which constitute the reward system of science—both then and now. And she writes of the ways in which, even before the First World War, the establishment of Nobel prizes was beginning to influence the direc-



Nobel's bequest influences the direction of research

tions of research; implicitly, subjects blessed with laureates have some form of official blessing, while those not so blessed are, it is assumed, ignored for equally good reason.

The study is interesting for many reasons. Strangely, Nobel himself was far from exact in his

will about how his wishes were to be executed. The money might easily have been spent in a number of different ways, were it not for diligence of the executors and their lawyer in resolving many of the legal issues surrounding the will. Credit is also due to at least one of Nobel's nephews for not contesting the will. In this respect, the example of history offered little encouragement to the executors: in 1874, an Italian merchant named Ponti had left 2 million francs for annual prizes to three scientific institutions in London, Paris and Vienna. The family contested the will, which was eventually declared void.

If the book has a defect, it is simply that the relevance of the study is not revealed. Scholarship is one thing, scholarship for its own sake quite another. For this reason, the book will not fulfil the claims of its publishers that "it will interest historians and scientists alike". It is far too detailed a work to be of much general interest. And why can't the publishers tell us who Elizabeth Crawford is? □

THE scientific study of the past is still young. Archaeology barely existed before the 1870s. And industrial archaeology did not develop as a separate discipline until the 1950s. So it is not surprising that people still disagree about what constitutes industrial archaeology.

Bradford-on-Avon, in Wiltshire, is perhaps best known for its Saxon church, which was discovered while being used as a warehouse in the 19th century. Between the 17th and 19th centuries, the town was a centre for the woollen trade. The River Avon provided transport for the cloth and for a while in the late 18th century and early 19th century it also provided power for the mills.

Kenneth Hudson, in *Industrial History from the Air*, picks out the main features in his aerial photographs—the Abbey and Kingdon Mills. In his potted history of the town, Hudson also makes the useful point that wealthy people built their houses near the centre of towns, until the 19th century. The flight to the suburbs was, at least in part, caused by the smog of the town centres.

Walter Minchinton, in *A*

Industrial heritage

Industrial History from the Air
by Kenneth Hudson, Cambridge UP, pp 136, £13.50
A Guide to Industrial Archaeology Sites in Britain
by Walter Minchinton, Granada, pp 256, £10.95

Mick Hamer



The roads of Dalmellington provide clues to the town's past

Guide to Industrial Archaeology Sites in Britain, mentions Bradford-on-Avon's mills (under "also worth visiting") and he also picks out the dry dock on the Kennet and Avon

canal as the town's most important relic.

For Minchinton, industrial archaeology is largely a question of early engineering. He operates an implicit historical cut

off, somewhere about the First World War. Hudson has no similar cut off (although that may have been forced on him by the availability of aerial photographs). So Hudson has a series of photographs on the development of Gatwick Airport, from the 1930s to the present day.

Aerial photography is a classic technique of archaeology, where crop marks reveal sites from the air that are undetectable from the ground. Hudson's photographs are strongest where they reveal unseen sites, as in the case of Dalmellington, a disused colliery. A whole estate of houses built between the First and Second World Wars, which served the pit until the 1960s, was demolished. The aerial photograph shows the estate roads. But more often than not the aerial photographs show nothing that could not have been shown just as clearly, by an ordinary photograph, or a map.

Minchinton's guide is not intended to be a bedside read, but rather a book to take on holiday. The sites are arranged county by county, and it will be a useful handbook for visitors, though the entries for most sites are restricted to two or three lines. □

SINCE the Second World War, wetland habitats have been disappearing rapidly. Draining the land to "improve" it for agricultural purposes has caused substantial losses and poses a serious threat to those wetlands that remain.

As this study shows, it is a problem of at least European dimensions. The timing of the process has varied greatly between countries. In Britain and The Netherlands, the rate of drainage has reached a peak and is probably declining. In the West of Ireland, drainage has accelerated recently. In France, the process is just beginning and the French authorities see that they have a long way to go before they match the achievements of their neighbours.

In all these countries the procedures are essentially the same though the institutions differ. The large-scale arterial works that are the key to further drainage are publicly funded and promoted. At the level of the field and the farm, where the destruction of the wetland is actually achieved, private initiative prevails, though a substantial proportion of the capital costs are met from the public purse, and the state frequently provides the spur in the form of advice and propaganda.

The end for the fens

Wetland Drainage in Europe: The Effects of Agricultural Policy in Four EEC Countries

by David Baldock, *Institute for European Environmental Policy and International Institute for Environment and Development*, pp 166, £5

John Bowers

The EEC directly contributes only a small part of the funds, except in western Ireland. But even if drainage is carried out at national expense, indeed, even if it were wholly privately funded, the EEC would be picking up the bill. The major objective of land drainage is to increase agricultural productivity. The EEC pays the cost of storage and disposal of the resulting agricultural surpluses. Furthermore, it provides the economic climate within which drainage becomes worthwhile: the high and guaranteed prices for agricultural output achieved through open-ended support buying arrangements.

Because the Common Agricultural Policy (CAP) is centrally funded, each member country has an incentive to expand its own output to the maximum, knowing that its

taxpayers and consumers will only meet part of the costs. Only national concern for the environment could put a check on



Old skills and valuable habitats are lost when wetlands are drained

this process, and that concern is presently insufficient.

The proper conclusion is that a common agricultural policy is doomed unless the EEC takes control of public investment in agriculture, of which land drainage is a major component. Such control is necessary because the benefits of investment are smaller for the Community than for the individual member countries. In a cost-benefit appraisal, the costs and benefits must be calculated for the whole area to which the policy applies, that is, all the member countries.

The EEC shows few signs of recognising this dilemma for its agricultural policy. As its draft directive on agricultural structures revealed, it continues to hold that improvements in productivity via such devices as land drainage are the key to solving the crisis of the CAP rather than the safe route to the policy's demise.

Regrettably, this book is unlikely to assist in changing that outlook. The descriptions of national policies and institutions and the assessments of damage caused by wetland drainage are excellent. But Baldock is weak on the socio-economic aspects of the problem. Some of the arguments are there, but they are not drawn together, nor are they put into a proper analytical framework. Consequently, the conclusions are brief and the necessary directions for change in the CAP are sadly missing. □

*Available from: Earthscan, 3 Endsleigh Street, London WC1H 0DD.

Isaac Asimov in Viking

The revised and updated edition of his classic work *The Intelligent Man's Guide to Science*

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£17.95

Ten stories of high-tech crime and suspense from established masters of the genre

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Edited by Isaac Asimov, Martin H. Greenberg and Charles G. Waugh

£10.95

Viking

Clear view of science

The Experience of Science
by Martin and Inge Goldstein, Plenum, pp 400, £22.50

Michael Shallis

HOW OFTEN teachers of science must have wanted a book that provides students with a clear picture of what science really is and how it is practised.

The Experience of Science provides a model example of such a book. Martin and Inge Goldstein are clear that science is one approach in the human endeavour to understand the world. And they believe that the study of the scientific approach is not only important if we are to comprehend the world we live in, but is also fascinating. Their text, therefore, is aimed both at non-scientists, for whom such a study will be part of their cultural understanding, and at science students, who usually only learn about science incidentally and rather sketchily

over the period of their formal training.

The Experience of Science is a full book and one that can be dipped into. It has chapters on facts, statistics and probability, measurement, hypothesis and theory, all simply written with a good eye for the human and historical example. Interwoven into this material are detailed case histories designed to explore and to illustrate the scientific method (and methods) in practice.

There is an excellent chapter concerned with John Snow and his theory of the cause of cholera, a detailed examination of the controversy between the caloric and kinetic theories of heat, and a long section on madness. All these studies can be read on their own; I found

them so enthralling I could not put the book down.

On every page the Goldsteins communicate the excitement, beauty and toil and discipline of science. They examine the flash of insight that can lead to a major advance in understanding, and the labour of experimental testing. They look at the myth of the dispassionate scientist by reference to Newton and Freud. And, finally, they produce a spellbinding look at the cultural roots of science, drawing parallels between science and belief in witchcraft.

It is good to see such a variety of material. And it is good to see so many fundamental questions about the nature of science, as it is practised, handled at a level of exposition that can be shared by so many readers. *The Experience of Science* is not a profound book but it is an important book. It is there to be used, and I hope there will be many users. They will not be disappointed and are bound to find much enjoyment in these pages. □

THE COMPUTER can either extend and amplify the power of the human imagination or it can propagate muddle.

Efforts are being made in Japan, the United States and Britain to make computers friendly and muddle resistant; and to extend their use to the automation of human information processing in new fields, such as medical diagnosis, fault-finding and data analysis. These new information systems are called "expert systems" because they capture some of the knowledge of human experts and make it available to the non-expert.

Expert systems work reasonably well where the knowledge has been consolidated and is well ordered. The best systems are fairly flexible and can take account of new knowledge as it becomes available. However, loose talk about capturing expertise can blind us to that too obvious fact: that experts are fallible. There is always the possibility that we might build some crooked thinking into our computer model by mistake, as we try to encapsulate the knowledge of our chosen expert.

A member of parliament once asked Charles Babbage, the 19th-century father of computing, "if you put into the machine the wrong figures, will the right answer come out?" Babbage was not able "rightly to comprehend the kind of confusion of ideas that would provoke such a question". One might imagine a modern select

Capturing expertise

Expert Systems: Concepts and Examples

by J. L. Alty and M. J. Coombs, NCC Publications*, pp 200, £10.95

Antony Anderson

committee of MPs, somewhat overawed and confused by the claims made for expert systems, asking Babbage: "If you feed in the facts will the right inference come out of the system?"

conventional program, even if all the input data were correct.

Expert Systems: Concepts and Examples makes no extravagant claims and it should dispel precisely this kind of confused



Argentin Press

Once he had educated the committee on this point, Babbage would then have to explain further that if the wrong rules were to be built into the expert system, it would, of course, reach invalid conclusions, in the same way that a wrong term inserted into an equation would cause an error in the output from a more

thinking. It treats expert systems as an extension of data processing, rather than something entirely new, and it is both interesting and informative. It explains the difference between the declarative computer languages, such as LISP and PROLOG, which are used in expert systems, and which are good at handling logical relationships,

and the better-known procedural languages, such as FORTRAN and BASIC, which solve problems step-by-step.

The first part of the book introduces the background concepts of expert systems and explains the fundamentals of predicate calculus and logical inference.

The second part covers practical examples. The authors have divided the examples into four classes: systems that handle uncertainty by building probabilities into their rules; systems that view a disease or a machine failure as a process of interlinked causes and effects; systems that start with an infinite number of possible outcomes and reach a solution by eliminating less likely solutions and which work well in fields such as mass spectrometry; and finally, those systems that can be used to help to design experiments and use a sort of computerised flow-chart approach.

This book provides an excellent introduction to the subject of expert systems and I recommend it for its clarity. Even the irascible Mr Babbage would derive some pleasure from reading it, because it describes an evaluation function for the game of tick-tack-toe, under its modern name of noughts and crosses. This was the game that Babbage once thought of automating in order to make money from the public to pay for his analytic machine. □

* Available from: The National Computing Centre Ltd, Oxford Road, Manchester M1 7ED.

ARTHUR C. CLARKE only managed to jump on the 1984 bandwagon by publishing this collection of essays under this particular title. Clarke is one of the greatest imaginative writers of "hard" science fiction, and his essays have little to do with George Orwell's work. Clarke does counter many of Orwell's fears with his own bright optimism about the social implications of information technology and about telecommunications in particular. He echoes Orwellian fears most nearly in his warning about the militarisation of space, but even here he tends to see technological solutions around the corner.

1984 Spring contains four sets of essays, the first two dealing with telecommunications and space flight, the last two with "the literary scene" (including essays on science fiction) and the "coast of coral" (Sri Lanka, tourism, creationism and other odds and ends). Some essays are clearly argued statements,

others are essentially memos, diary jottings or verbal doodlings.

In the first two sections, his main arguments seem to boil down to a deep conviction that new technologies can bring the human race out of the stone age, and that space flight is the greatest challenge of our time. Although I disagree with much of this, the gusto with which Clarke writes, and the information he adduces, makes the better essays a great pleasure to read.

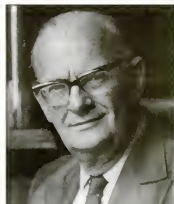
The collection contains many flashes of

Future tense

1984 Spring: A Choice of Futures

by Arthur C. Clarke, Granada, pp 308, £8.95

Ian Miles



Clarens Agency

Clarke's essays have little to do with Orwell

the wit and the gift for putting together technological trends for which Clarke is renowned. But it is not a book to read at one sitting, for there is considerable overlap between the essays, many of which were originally speeches.

For example, the very first essay in the book quotes from an earlier speech, which happens to be the second essay. The same themes are worked over repeatedly, often in the same words, and generally with no significantly different conclusions arising. We can only regret that Clarke chose to republish these essays as they stand rather than integrating them in a new version of his classic work of futurology, *Profiles of the Future* (Gollancz, 1982).

But having said that, there are many things to enjoy about this collection, if it is treated as a bedside book for dipping into rather than a serious examination of possibilities for the human race that the publishers claim it to be. □

Requiem for the rainforest people

The Hidden Peoples of the Amazon

A new exhibition at The Museum of Mankind celebrates the life and culture of an endangered species—the forest Indian of South America

Gail Vines

ETHNOGRAPHERS, the cataloguers of culture, have a problem. The detritus of a people—its baubles, tools, pots and pans—does not give it away, however revealing a preference for furnishings from Habitat may be within our own society. The attempt to convey a sense of the people of the Amazonian rainforest in two rooms off Piccadilly is a tall order.

The Museum of Mankind has, however, done its best. It is now exhibiting a haul of handicrafts collected in the early 1960s, together with objects gathered more recently by Stephen Hugh-Jones, reader in anthropology at Cambridge University and an initiate of a tribe of Indians living in northwest Amazonia.

Pride of place in the exhibition, a year in the making and on show for at least a year, is a reconstruction of a maloca, the communal dwelling place of the Tukano. It is, we are told, symbolic of the cosmos for these Indians. Men enter by the



The Indians will soon be gone but the beads will be preserved

front door, women by the back.

Life is clearly more exciting for the men. They wear elaborate ceremonial garb, go off with their fellows wielding blow dart and bow and arrow, and spend

the evenings recuperating with beer, tobacco and hallucinogenic plants. "The women sit outside the circle of men and usually go earlier to their hammocks in the family sleeping quarters."

The women, it seems, are the farmers and the cooks, growing and detoxifying the staple food, manioc. But we hear nothing for instance, about what it is like to give birth and raise children in such a society.

Sexual politics aside, the exhibit overwhelmingly conveys the feeling of a people catalogued because they will not be here much longer. The exhibit ends with photographs of a very scantily clad Indian astride a Yamaha bike, a maloca transformed into an industrial storage depot, and a rainforest turned into barren mud. For all the evocation of the Indians' way of life—from the strains of panpipes floating over the loudspeakers to the simulated forest gloom—we are left with no information about why rainforests are being destroyed and no sense of what we could do about it. In 30 years' time it will all be gone, we are told. Good that we have all their worldly goods in our Museum of Mankind. □

RADIO 4's new programme on technology carried both good and bad news into the airwaves. The good news is that the programme exists at all. For too long Radio 4 has worked to an exceedingly narrow definition of science. The programme *Science Now* gathers too many items from papers in *Nature* or journals that are even more esoteric.

A programme about technology gives Radio 4 a chance to broaden its horizons and to bring us science in action rather than aspic.

The bad news is that the new programme on technology has to overcome the name *Hi-Tech*. If the producers stick to their title, they must eschew "low tech" or appropriate technology, thus denying the programme access to one of the more fruitful areas for discussion in recent years.

So much for the framework, what about the first programme? It was a promising start.

The people interviewed in *Hi-Tech* were better at explaining their work than the researchers who invariably populate the science programme. I had always thought that scientists fail to communicate in writing because of the conventions of their literature. It turns out that

Technology gets a foot in the door

they talk as they write. Perhaps this is why *Science Now* lacks the appeal of *Law in Action* or *In Touch*, to pluck out of the air two programmes that never fail to interest and even to amuse.

The first *Hi-Tech* (21 March) covered subjects that were worthy although a little unexciting. The best item was on oil rigs in the North Sea and what will happen to them when they reach the end of their useful lives. (Tow them somewhere else and turn them into breeding grounds for fish, is one solution.) That people who complain that nuclear power stations are built without much thought for what will happen when the day comes to decommission them should look over the horizon to the North Sea. The place is littered with danger-



Michael Kenward

ous structures that no one knows how to dismantle when their job is done. As one expert admitted, the industry will do only as much as it needs to satisfy the law. Unfortunately,

law usually finds itself picking up the pieces after a disaster whereas what we really need is legislation to prevent the disasters.

An odd little bit on "electrorheological fluids" probably belonged in the science programme. Finally, we had an item on car tyres. Once again, interesting enough, but far from the cruel world of commercial reality.

The presenter, Alun Lewis, is better than his colleagues on *Science Now*, who too often are oh so carefully enunciating cleverly crafted copy more

suited to the page than the airwaves. Given time, Jones may reach the high standard set by Geoff Watts on *Medicine Now*. *Hi-Tech* deserves time to find its feet, and people who can talk clearly and enthusiastically about what is, after all, one of the most important areas of human activity today.

Fascinating "scientific" items turn up elsewhere on Radio 4. As well as fish farming on *The Food Programme*, appropriately at lunchtime on Sunday, on Saturday night, *Soundings*, from the religious department of Radio 4, considered the way in which religion and "the new physics" come together. John Polkinghorne, Paul Davies, David Bohm, Jim Lovelock and Fred Hoyle showed that there are scientists out there who can talk in language understandable outside the common room. The presenter seemed to be convinced that the scientists' approach to the origin of the Universe brings them nearer to an understanding of our maker. It was as if he wanted someone to say that science is about to prove the existence of God. The scientists he talked to don't see it in these terms—perhaps he should have talked to some of the more mystically inclined scientists in California. □

This week's contributors

Antony Anderson is an engineer with a passion for computers.

John Bowers lectures in economics at Leeds University.

Robin Clarke is a writer on environmental issues.

Ian Miles is at the Science Policy Research Unit at Sussex University.

Michael Shells is an astrophysicist and staff tutor in physical sciences in the department of external studies, Oxford University.

LETTERS

Light the way

What a pleasure it is to read of proposed coloured lights to be fitted to all cars which would flash when the speed limit was exceeded (Letters, 7 March, p. 50).

However, as such the information transmitted would be grossly inadequate. Drivers with personal problems—financial or domestic or recent bereavements, for example—are obviously more likely to cause accidents and should carry additional light(s) to indicate that they may not be paying proper attention. All cars with engines above 1000 cc should have a further lamp and eventually pedestrians should also be fitted with helmets indicating that having had a pub lunch, for example, they are more likely to cause an accident, with another lamp for the unemployed or over 45s.

J. C. Beresford
Abu Dhabi

Ethiopian disaster

Are North Ethiopians abandoning their land as Michael Cross claims (This Week, 14 March, p. 8), or are they being forced by the government for its ludicrous motives?

Had it not been at a very critical moment where they have to choose between life and death, the people of Tigray and Wollo would certainly prefer to die at their home with pride and dignity like the rest of their fellow countrymen. Who would like to die at the newly created disaster areas, 2000 miles away from his home?

Not only is the problem of the Omo river being, "infested with malaria and sleeping sickness," but also the war in the south is catastrophic—forced labour in the concentration camps and the absence of democratic and civil rights, are tragic episodes. The Relief and Rehabilitation Commission (RRC), headed by Col Dawit Wolde Giorgis, the former Governor General of Eritrea, seems to be immune to the international criticisms forwarded

to it from different corners. Thus, criticisms are becoming commonplace and ineffective from conveying their messages.

To this predicament, the inevitable sufferers are the drought, famine and war victims of North Ethiopia. Drought and famine are proving to be a blessing in disguise to the war the Ethiopian government is waging. The hard-line stand of the rebel forces in the north hasn't helped in overcoming the problem either.

Had the full scope of the agony and holocaust been portrayed, more people would have condemned the atrocities of the Ethiopian government. But here we are in the last years of the 20th century, where the military regime of Addis Ababa is enjoying the misery of uprooting millions of voiceless people of North Ethiopia.

North Ethiopians are not abandoning their homes at will but at gun point.
Wolde Selassie Asfaw
London NW1

Sinclair resistance

Chris Pollard criticised the claims we have made for the C5 (Letters, 14 March, p. 45). I am afraid his criticisms are not justified.

The Topper sailing dinghy did indeed use larger mouldings than the C5 and we learned much from it. However, it was not a vehicle, and requirements were very different.

The government regulation requires the motor to have a continuous rating of 230 watts output. If we limited the battery to 21 amps, as Pollard suggests, we would have a very feeble vehicle, indeed. The battery has to deliver peak powers approaching a kilowatt and the peak output of the motor is allowed to exceed 250 watts. Even if it were not, the losses applying under start-up conditions means that a very much higher power is demanded of the battery than is delivered to the road.

Pollard says that it is certainly not true that aerodynamic shape is



more important than weight at 15 miles/hour. He is wrong. Rolling resistance of the C5's wheels is extremely low. Wind resistance is the overwhelmingly dominating loss at 15 miles/hour. It is a very common misconception that wind resistance does not matter below say 30 miles/hour, but if you go to the trouble (necessary in the case of an electric vehicle) to minimise rolling resistance, wind resistance is dominant and a low drag vital.

As for the remainder of Pollard's remarks, it is clear he has not driven a C5. I do so wish that he and others would try the vehicle first and criticise second. Enormous attention to detail went into its design and we are proud of the results. Constructive criticism is always welcome, but erroneous statements just mislead your readers.

Clive Sinclair
London SW1

Chemical elements

I am very disconcerted to read that a new periodic table has been agreed, with the "main" groups renumbered 1, 2, 13, 14, 15, 16, 17 and 18 instead of 1 to 8 ("Mendeleev's dream table", 7 March, p. 32). Whatever advantages this might have for chemists in universities and research (and I cannot see many), it is a quite disastrous change for school children beginning their study of chemistry.

As a school teacher, I know how very useful it is for beginners to be able to relate the main group numbers to the numbers of outer-shell electrons, and hence to the characteristic oxidation numbers shown by the elements; just as the number of the Period can usefully be related to the number of shells.

Surely it is more important to help young beginners to make sense out of the complexities of chemistry than to insist on some kind of esthetic significance to the number 18? After all—if 18, why not 32, and include the lanthanides as well?

The idea of numbering the main groups M1 to M8, and the transition groups T1 to T10 (corresponding to the "extra" d-electrons) is far more logical. Further, one could label the lanthanides L1 to L14, making a logical and complete system.

I feel that educational groups should have been consulted before making this change, and I very much hope that IUPAC will come out of its "ivory tower" and reconsider. I shall be grateful therefore if you can pass this letter on to the "powers-that-be" at IUPAC, or else send me details of where I should address a letter to them.

M. H. James
Farnborough Hill School
Surrey

As a teacher of chemistry in a secondary school, I welcome your revised version of the Periodic Table. I believe that by removing what many of my pupils see as inconsistencies in older versions you will make their lives—and mine—easier.

However, you have perpetuated one inconsistency: when we write atomic species we do as: Li for example. "But sir, that can't be right..." Please can we have a 2nd (educational) edition with atomic number and atomic mass in the "right" place?

D. C. Fife
Atherstone
Warwickshire

GRIMBLETON DOWN

GILLBRAND HAS BEEN CHARGED UNDER THE OFFICIAL SECRETS ACT, BUT SHE IS NOT ONE OF MY TOP SCIENTISTS AND HAS NO ACCESS TO CLASSIFIED—



THE PREJUDICE AGAINST WOMEN IN SCIENCE SHE WAS HIGHLY QUALIFIED AND COULD HAVE PROVIDED ON VALUABLE INFORMATION—



I'D TEAR HER HAIR OUT!



Bill Tidy

Star gazers

You state "It is nice to know that people have a fair contempt for astrology" (21 February, p 2). You seem to imply that this is because people do have some knowledge of science, even though, on the whole, they are "decidedly ignorant". If people do have contempt, a more likely reason is that, being influenced by popular astrology and popular scientists, they are totally unaware of astrology proper, as distinct from media astrology.

Champions of the new science launched a propaganda campaign against astrology at the end of the 17th century, which was probably necessary at the time. But it is sad to bear "new" scientists still purporting this today, at a time when the research of Gauquelin and others has demonstrated that it does have some validity, and when many physicists no longer have a simple physicist's conception of the universe.

Respondents in the opinion poll said funding for astrology should be limited and not given priority. It does not follow that they have contempt, fair or unfair. Of course, its funding should be limited, and not of



the same quantity as say medical research. But as yet astrological research receives no funding apart from two or three PhD students, and relies on the dedication of a few workers willing to give up much of their spare time for it.

Martin Budd
Graham Douglas
Radical Astrology Group
Wandsworth
London

Black clouds

There is much in Sir Douglas Black's article on Sellafield (7 March, p 12) with which even his sternest critics would agree. Thus, there is no doubt about the inability of epidemiological studies to provide indisputable evidence of causality. Equally, no one disputes that a causal relationship between Sellafield discharges and local cases of childhood leukaemia is biologically possible.

It is widely realised that radioactive contamination along the Cumbrian coast is unique, both in terms of level, and duration of exposure, that the alpha discharges result in bone-marrow exposures which are unparalleled in any other civilian population, and that the placenta

does not offer an effective barrier to fetal exposure. Consequently, if nuclear establishments are going to produce any biological effects at all, it is in the population of Cumbria that those effects will be most apparent.

Black's inquiry identified some biological phenomena, but omitted several factors. For example, it failed to mention that of the 675 electoral wards surveyed in the North of England, four of the ten with the highest incidence of leukaemia are located along the Cumbrian coastline. It excluded two cases of leukaemia diagnosed in Seneale in 1983, and did not update its information on the other "top ten" electoral wards. It failed to observe that leukaemia was not the only malignancy present in excess around Sellafield. It failed to draw the obvious parallel between Cumbria and Denver, where increased rates of malignancy, including leukaemia, has been documented downwind of a local plutonium production plant, which also caught fire in the late 1950s.

Black argues that the causal relationship between Sellafield discharges and local cases of childhood leukaemia is no more than a possibility. Yet, he fails to consider any of the above points, all of which support the causal hypothesis. Instead, he presents two new arguments in support of his own position, both of which are of doubtful scientific value.

First, he argues that, if the incidence of leukaemia in Cumbrian children returns to normal as the radioactive discharges are reduced, then that will reinforce the causal hypothesis. In fact, one could argue the opposite case equally well. Since plutonium-239 has a half-life of 24,000 years, and since americium-241 is being formed from the decay of plutonium-241 at a rate which will increase over the next 50 years, the high incidence of leukaemia in Cumbria could be maintained well into the next century.

Black also argues that ionising radiation is associated with myeloid rather than lymphatic leukaemia. This argument is equally specious. Chronic lymphatic leukaemia may not be related to radiation, but excess numbers of cases of acute lymphoblastic leukaemia have been found in atomic-bomb survivors from Japan. If Black believes that the incidence of acute lymphoblastic leukaemia in Cumbrian children argues against a radiation link, he has been seriously misinformed by his scientific advisers.

Finally, Black avoids the main issue in pretending that the only solution is closure of the reprocessing plant. Environmental groups are only too aware that Sellafield fulfils a military role, which the government regards as indispensable. The current proposal is to lower the authorisation limits, but this will still allow British Nuclear Fuels to discharge several hundred curies of alpha-emitters annually.

Sellafield will remain the dirtiest nuclear facility in Europe.

R. Russell Jones
Stoke Poges, Bucks

AIDS omissions

My attention has been drawn to Omar Sattar's article "How Gallo got credit for AIDS discovery" (This Week, 7 February, p 3) and to the subsequent indignant letter from Dr Robin Weiss (28 February, p 45).

Weiss accuses Sattar of two sins of omission. Indeed, there are omissions, but I think these are the following:

1. That a paper was submitted by Gallo to *Science* on 12 December 1983 (published in 1984, vol 224) which provided further evidence that HTLV I was involved in AIDS, with no mention yet of HTLV III. Four further papers in *Science* (1984, vol 224) were submitted on 30 March 1984, which claimed that a new virus (HTLV III) had been isolated from AIDS patients. Thus in just over three months in early 1984, Gallo had abruptly changed his mind.

2. That Montagnier supplied Gallo with LAV first isolate on 17 July and 23 September 1983 ("AIDS priority", *Nature*, 9 August 1984). According to Gallo, the first sample failed to grow in his laboratory, but the second did. Thus it appears that Gallo may have discovered HTLV III about the same time as he first succeeded in growing LAV.

3. That the sequences of LAV and HTLV III are practically identical (less than 1 per cent difference) while the sequence from the other US isolate differs by 10 per cent (10/22, 28 February 1985, p 743). Must we really suppose the New York partner of the French homosexual provided Gallo (*Nature*, 21 February 1985, p 636) with the bilingual virus in 1982 (LAV/HTLV III)? There had been no mention of this 1982 isolate until after two other sequences of independently isolated AIDS viruses had been published.

A. Karpas
Department of Haematological
Medicine
University of Cambridge

Blood money

Stephen O'Sullivan, in his article "The unacceptable face of blood banks" showed a classic case of middle argument (Forum, 21 February, p 37).

As I understand it, he suggested that:

- Britain, not yet self-sufficient in all human blood products, is importing products from the US.
- Products from the US are adding to the risk of AIDS.
- British products would be safer.
- In the US, plasma donations are obtained on a wide scale, hence there is sufficient plasma to satisfy internal needs and so excess to be exported.
- Plasma donations in the US are encouraged by paying donors.



● If we paid plasma donors in Britain, we should have sufficient plasma to satisfy all our needs and become self-sufficient.

The point O'Sullivan has missed, is that it is because plasma donations are paid for in the US that the products are less safe. The reason that British products are safer, is that they are donated freely. Once a financial element is introduced into blood or plasma donations, the motive for giving is changed. Many "volunteers" then donate—not to provide a gift for another human being less fortunate, but in order to obtain money for the next "fix" or whatever. If plasma donors were to be paid in Britain we would have exactly the same problems as the US with increased risks of contaminating the plasma pools in this country.

Stephen O'Sullivan's title, and the substance of the article, are correct. Paid blood donors do increase the risks, and this, in the eyes of British blood-transfusion centres, is "the unacceptable face of blood banks".
Patricia E. Hewitt
National Blood Transfusion Service
Edgware
Middlesex

Added dimension

In "The Universe: inflation out of chaos" (7 March, p 14), Andrei Linde states that in a two-dimensional universe, "neither gravity nor electromagnetism is affected by distance at all". This is surely incorrect. If in an n -dimensional universe, the result is always a $0-1$ power law, it follows that in a two-dimensional universe, force would be inversely proportional to distance (to the power of one).
Osman Ahsan
London NW1

A crucial few words were omitted from this article during editing. The relevant sentence should have read "In a two-dimensional Universe, things are no better, because $n-1=1$, and in a one-dimensional Universe, neither gravity nor electromagnetism is affected by distance at all". The omitted words are italicised.

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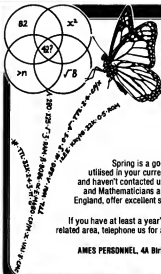
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It is hoped shortly to make an appointment at University Lecturer or University Demonstrator level in the field of optical and electronic properties of semiconductors, heterojunctions and superlattices. The Department has strong research programmes in this field and is due to receive further advanced research apparatus in the near future in connection with a number of collaborative projects.

Applicants, who should be under 35 years of age, should have high qualifications and significant experience.

The successful applicant will be expected to undertake undergraduate teaching duties.

Salary on the scale £10 330 to £15 930 pa (University Lecturer) or £7960 to £9860 pa (University Demonstrator).

Further information concerning the duties and conditions of appointment may be obtained from the Secretary of the Appointments Committee for the Faculty of Physics and Chemistry, Institute of Astronomy, Madingley Road, Cambridge CB3 0HA, to whom applications (10 copies—overseas candidates need send only one copy), including a cv and the names of not more than three referees, should be sent so as to reach him not later than 6 May 1985.

GRADUATE RUBBER & PLASTICS SPECIALIST

THORN EMI, the largest consumer electrical company in the U.K. is expanding its Central Research Laboratories to meet the demand for tomorrow's products. We are seeking Graduate Scientists and Engineers to work in our New Laboratory Complex which houses one of the world's most innovative research establishments and is situated in the high technology centre of Southeast England.

One of these exciting research opportunities is for a Rubber and Plastics Specialist with a good degree in Materials Technology and at least 3 years' R&D experience in the Rubber Industry. Initially he or she will be engaged on research into new Flexible Composite Materials but academic and product knowledge will be commensurate with involvement in other materials research in the long term.

Very attractive salaries (c. £12K for this particular vacancy) and conditions of employment with excellent prospects for career development are offered to those who can make a significant contribution to the research in this, or any other discipline. For further details please contact our Personnel Manager, Harry Hogg.



THORN EMI Central Research Laboratories

FREEPOST, DAWLEY ROAD, HAYES, MIDDLESEX UB3 1BR

TEL: 01-573 3888 Ext 2870

MATHEMATICAL MODELLER/SYSTEMS ANALYST

SOUTH AFRICA

Leading Consulting Engineers in Johannesburg, South Africa, urgently require a Mathematical Modeller for an expanding unit concerned with the planning, design and optimal management of water resource systems. This unit has developed computer models for the solution of a variety of hydrological and pollution problems and for engineering analyses such as water hammer, refraction networks and arch dams, and is now diversifying into other fields.

Applicants should be in their late twenties or early thirties with a postgraduate degree and experience in systems analysis and modelling, and preferably also in one or more of the following:

Hydrology Simulation Modelling
Hydraulics Optimization Techniques
Engineering Programming Stochastic Modelling

The post allows almost unlimited access to a prime IBM 310 computer.

Salary negotiable.

Replies will be treated in strict confidence and it is anticipated that interviews will take place in mid-April. Reply with CV and usual personal information to—

The Advertiser Box Number D857.

Technical Services Chemist

c£9,000 p.a. Enfield, Middlesex

This leading pharmaceutical manufacturer is a major supplier to the NHS.

The successful candidate will join a small team in the Technical Services Laboratory responsible for optimising yields and minimising costs of both existing and new processes. Some small scale complex preparative work is also undertaken.

Applicants should have an appropriate chemistry degree, a minimum of 2-3 years relevant experience and preferably be familiar with pharmaceutical goods manufacturing practice.

You can expect an attractive starting salary and other major company benefits.

Send full c.v. to: Tony Colpin, PER, 4th Floor, Rex House, 4/12 Regent St., London SW1Y 4PP.

PER

Professional
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UNIVERSITY OF SURREY Department of Chemical and Process Engineering

'NEW BLOOD' LECTURESHIP IN PROCESS BIOTECHNOLOGY

Applications are invited for a 'New Blood' post in Process Biotechnology, to work specifically on the dynamics of cell cultures. The successful applicant will be expected to collaborate with other members of the Department of Chemical and Process Engineering and with members of the Department of Microbiology in developing a major programme of research into the engineering of animal cell cultures, and also in developing new teaching activities in Process Biotechnology.

The successful applicant will have a PhD or equivalent research experience, and will be capable of applying advanced mathematical techniques to the analysis of cell cultures. Graduates from a range of disciplines including chemical or process engineering, control engineering and applied mathematics will be considered.

The post is tenable from 1 August, 1985 and applicants should normally be under the age of 35 years. The post is not open to persons holding a permanent university appointment in the United Kingdom of whatever kind. The salary will be within the Lecturer scale, £7520-£14 925 pa, according to age, qualifications and experience.

Further particulars are available from the Academic Registrar (AA), University of Surrey, Guildford, Surrey, GU2 5XH, or Tel Guildford (0483) 971281, Ext 83. Applications from men and women, in the form of a cv, including the names and addresses of three referees, should be sent to the Academic Registrar by 26 April, 1985 quoting the reference 367/NB.

University of East Anglia Norwich

LECTURER IN ENVIRONMENTAL CHEMISTRY (Biogeochemical Cycling)

This lectureship, in the School of Environmental Sciences, is available from 1 October, 1985 under the UCEA 'New Blood' scheme.

The primary role of the lecturer in the early years will be to contribute substantially to research. Salary on the scale £7520-£14 925 per annum (under review) plus USS benefits.

Applications are invited from chemists (including geo- and bio-chemists) or microbiologists, with an interest in aspects of biologically mediated exchange of chemical elements between sediments, soils, fresh and marine waters, and the atmosphere. Applicants should not be more than 35 years of age.

Applications (three copies) which should contain a full curriculum vitae, including exact date of birth, together with the names and addresses of three persons to whom reference may be made, should be lodged with the Establishments Officer, University of East Anglia, Norwich NR4 7TJ (telephone 0603 56161 ext 2126) from whom further particulars may be obtained, not later than 6 May, 1985. No forms of application are issued.

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Ferranti Computer Systems Limited is at the forefront of design and manufacture of computer equipment and systems for real time applications. The Wythenshawe Division, just a few miles south of Manchester, is the focal point for commercial operations based on the proven success of the Ferranti ARGUS range and other computers.

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Experience must include CORAL, PASCAL, FORTRAN or C.

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With experience in any of the areas indicated for the Senior Design Engineers.

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Experienced in the development of microprocessor based products—ideally using Intel or Zilog Assemblers.

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Salaries are in the areas indicated and benefits include generous relocation expenses.

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Write with detailed c.v., or telephone for an application form, to: Ann Saggerson, Training & Resources Manager, Ferranti Computer Systems Limited, Wythenshawe Division, Simonsway, Wythenshawe, Manchester, M22 5LA.

Tel: 061 499 3555.

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SCIENTIFIC ANALYST/ PROGRAMMER

Horsham, West Sussex

A vacancy has arisen for a qualified analyst/programmer in the Research Support Group of the Management Information Services Department at Ciba-Geigy Pharmaceuticals in Horsham, West Sussex. The range of work covered by the Group includes laboratory automation and the implementation of scientific applications onto micro-computers, minicomputers and mainframes.

The successful candidate (male/female) will initially assist in the setting up of an Electronic Laboratory using the DEC Vax minicomputer as the hub of this new application. Thereafter duties will involve support work for the other aspects of the Group's work.

We are seeking someone, educated to degree level, trained in a scientific discipline who has worked for at least 3 years in programming with experience in systems analysis. Major personal aptitudes required include a self-starting ability, and the capacity to enjoy the challenge of a job which carries a great deal of personal responsibility.

The salary and benefits package for this position is very attractive and will include relocation expenses where appropriate.

Please write in or telephone for an application form to:

Ken Gilliver, Employee Resource Manager,
Ciba-Geigy Pharmaceuticals, Wimblehurst Road, Horsham,
West Sussex, RH12 4AB. Telephone: Horsham 50101

CIBA-GEIGY

EAST MALLING RESEARCH STATION

GRADUATE BOTANIST/ PLANT PHYSIOLOGIST

to research causes and control of wastage in stored Bramley apples due to physiological disorders and bruising.

Salary in scale £5800-£8153. Superannuation. Appointment for three years.

HIGHER SCIENTIFIC OFFICER FOR SOILS RESEARCH

Honours graduate in soil science or a related field with strong interest in agronomy or horticulture required to work on orchard soil management regimes and their effects on soils and fruits. Salary in scale £7435-£10 039. Superannuation. Appointment for three years.

HIGHER SCIENTIFIC OFFICER

Research post funded to 31 December, 1987, available within group investigating somaclonal variation in strawberries. The successful applicant will be responsible for developing methods for strawberry protoplast culture, design and application of appropriate selection procedures and regeneration of plants.

Qualifications: good honours degree preferably with PhD or at least two years postgraduate research in an appropriate biological discipline. Experience of protoplast and/or tissue culture essential. Biochemical or molecular biological training useful.

Salary in scale £7435-£10 039. Superannuation.

3 YEAR NEW INITIATIVE POST

Available for research on "calcium-dependent metabolic regulations in relation to fruit quality" to develop an appropriate biochemical programme, examining cellular calcium-calmodulin control processes, especially in apple fruit.

Good honours degree with post graduate experience and biochemical training. PhD preferred. Familiarity with calcium biochemistry an advantage.

Salary scale £7435-£10 039.

Non contributory superannuation scheme.

Further details for all posts from Secretary, East Malling Research Station, Maidstone, Kent ME19 6BJ. Closing date 12 April 1985.

East Malling Research Station is an equal opportunities employer.

Information Project Worker

LONDON HAZARDS CENTRE

The London Hazards Centre is a GLC-funded service which provides advice, information and help on workplace and environmental hazards to trade union and community groups. The seven Centres workers operate as a collective.

We now have funding for a two year project to set up a network of case-based hazard information, using the Polytechnic of the South Bank's mainframe computer. Pilot work on the project has been carried out by the existing workers.

The new worker must be prepared to share a large volume of routine clerical work as well as intensive project work. He or she will study have experience in all or some of the following areas:

- * Library Work
- * Information services/systems development
- * Computing—mainframe, minicomputer, database management, online searching, wordprocessing/Amstrad, etc.
- * Work with trade union or community organisations
- * Knowledge of health & safety information/hazards

If you have a commitment to the radical use of information, write to us for an application form

London Hazards Centre at the Polytechnic of the South Bank, 133 Borough Road, London SE1 1NA.

Closing Date: Wednesday 10 April, 1985. The London Hazards Centre is an equal opportunity employer and has a zero penalty policy—concerns £12 000 pa

DEVELOPMENT ENGINEER

Small Medical Devices Company is growing and needs an engineer with proven mechanical engineering and design skills.

Candidates should be graduates 25-35 years old with a minimum three years industry experience.

This is an attractive opportunity to join a young team engaged in product development and prototyping of specialised medical devices.

Ours is a business with a future and to match our ambitious growth plans we offer challenge and hard work in return for good remuneration, a positive work environment and exciting career prospects.

We look forward to welcoming the right person.

Applicants please submit cv to The Managing Director, Bellhouse Medical Products Ltd, Larkhill House, Abingdon, Oxon OX14 1AS.

DEPARTMENT OF SURGERY University of Edinburgh Medical School, Teviot Place, Edinburgh

A GRADUATE RESEARCH ASSOCIATE

is required to extend our research programme on the immunological effects of seminal plasma. This post is for one year in the first instance with extension for a further two years subject to progress. Preference will be given to applicants with experience in either immunology, cell biology or biochemistry. The salary will be in the range £6600-£7520 according to age and experience.

Applicants, including full curriculum vitae and the names of two referees should be sent to: Dr Keith James, Department of Surgery, University of Edinburgh Medical School, Teviot Place, Edinburgh EH8 8AG. For further details contact the above.

PLEASE QUOTE REFERENCE NO 5238

UNIVERSITY OF ST ANDREWS

'New Blood' Lectureship in Solid State Chemistry

Applications are invited for a Lectureship in the Department of Chemistry. Candidates should be no more than 35 years old and should not hold a permanent University appointment in the United Kingdom. The salary for the post will be in the range £7520-£14725 (per annum (under review), plus USS.

It is hoped that the person appointed will interact closely with the group in the above Department currently working on solid state electrolyte conducting systems, with the organic research group headed by Professor D J Cole-Hamilton, and with the semi-conductor research group in the Department of Physics.

Applications (three copies preferably in typescript) with a curriculum vitae and the names and addresses of three referees, should be received not later than 1 May 1985 by The Employments Officer, The University, College Gate, St Andrews, Fife KY16 9AL, from whom further particulars may be obtained.

Graduate Toxicologist

WARE, Herts.

The Glaxo success story is the envy of the pharmaceutical world and is based, quite simply, on the quality of both our research and the people who work here. It is an approach that has made us the foremost pharmaceutical company in the UK with a formidable range of successful products.

To maintain our leading position we are seeking a Graduate Toxicologist who will supervise and participate in the performance of our safety evaluation studies. You will also be expected to collate and interpret study data and formally report the results obtained.

For this demanding post you will need at least 2 years' relevant experience preferably obtained within the pharmaceutical industry or similar.

You will be expected to have proven organisational ability and be fully conversant with GLP requirements.

Familiarity with the computer processing of study data would be a distinct advantage.

If you believe you can meet these criteria then we are eager to hear from you.

We can offer a competitive salary and an attractive benefits package including a non-contributory pension scheme, a profit-sharing bonus scheme and, where appropriate, generous relocation expenses.

For an application form, write or telephone, without delay to: Dr. J. R. Hare, Personnel Officer, Glaxo Group Research Ltd., Ware, Herts SG12 0DJ. Tel: Ware (0920) 3993.

Glaxo Group Research Ltd.

CHEMISTS

The continued expansion of operations at our Mostyn, North Wales site, necessitates the appointment of technically qualified staff to carry out research, development and analytical development on the Company's expanding range of chemical products.

ANALYTICAL CHEMIST

To carry out analytical method development work on a wide range of chemicals. Candidates should be qualified to degree level and have relevant experience in modern instrumental analysis.

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To assist in the development and testing of new product formulations and to carry out customer service work. Candidates should be qualified to HNC level or equivalent and preferably have some experience in the detergent or water treatment industry.

Applications containing relevant career and personal details should be sent to:

The Technical Manager,
WARWICK INTERNATIONAL LTD,
Chemicals Division,
Mostyn,
Holywell,
Clwyd CH8 9HE



Biostatistician Pharmaceutical Industry Maidenhead, Berkshire.

As a leading international pharmaceutical company we can offer a unique and challenging position to a Biostatistician with at least 2 years' experience.

Collaborating with medical personnel, the main task of the Statistician will be the analysis of clinical trials and the writing of statistical reports. In addition, the Statistician will collaborate closely with medical personnel in the design of clinical studies. Experience in working with clinicians as well as strong written and verbal communication skills is therefore desirable.

You should possess an MSc or PhD in Biostatistics or Statistics and have an understanding of the basic Biological Sciences. Since extensive use is made of timesharing computer facilities, you should be familiar with the use of computers in the context of clinical trials.

An excellent salary and benefits package is offered, and the potential for career growth is considerable.

For an application form and job description, please contact: Diana Blandin,
Syntex Pharmaceuticals Limited,
Syntex House, St. Ives Road, Maidenhead,
Berk. Tel: Maidenhead (0628) 33191.



BP is Britain's largest and one of the world's most successful companies.

BP Research Centre provides Group companies with comprehensive research and development facilities for the support of existing business areas and for the exploitation of new businesses. Our increasing commitment in the area of surface coatings has led to an additional opportunity for a

Paint Technologist

to join an established team carrying out research into all aspects of paint technology. In particular, you will be involved in developing and assessing novel paint components and liaising with potential and existing customers.

Ideally aged 24 to 35, you should have at least three years' industrial experience in the formulation and testing of metal priming paints. Experience of the paint industry in a technical service capacity would be desirable.

An excellent salary and benefits package includes a non-contributory pension scheme, subsidised restaurant, extensive on-site sports and social facilities and relocation assistance, where appropriate.

Please write with a CV or telephone for an application form, quoting reference SR 6731, to: Anne Sheppard, British Petroleum Company plc, BP Research Centre, Chertsey Road, Sunbury-on-Thames, Middx TW16 7LN. Tel: Sunbury-on-Thames (09327) 62028.

BP is an equal opportunity employer.

BP Research SUNBURY-ON-THAMES

MRC MEDICAL RESEARCH COUNCIL
Medical Research Council
Laboratory of Molecular Biology,
Cambridge

POSTDOCTORAL SCIENTIST

Applicants are invited from postdoctoral scientists to work on a project led by Dr A. Klug on the structure of chromatin and the interaction of a regulatory protein with DNA. Experience in both protein and nucleic acid chemistry would be advantageous but not essential.

The post is available for three years and the salary will be in the range £8820-£13 120. Further information from the Assistant Director (Administration), MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH.

Applications—including a full CV and the names of two professional referees—should be sent by three weeks after appearance quoting reference BL/7 to: The Assistant Director (Administration), MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH.

UNIVERSITY OF LIVERPOOL Department of Statistics and Computational Mathematics EXPERIMENTAL OFFICER

to assist with development and maintenance of software for research and teaching.

The successful applicant will work within the computational mathematics group and the minimum qualification is a first degree in numerical analysis, mathematics, computer science, or a related area. Computing experience in one or more scientific high level languages is also a requirement.

Salary within the range £6600-£8920 pa.

Application forms may be obtained from the Registrar, The University, PO Box 147, Liverpool L69 3BX.

Quote Ref: RV/204/NB.



BIOCHEMICAL ENGINEER

The Pulp and Paper Research Institute of Canada has an opening for a biochemical engineer for an NRC-funded project on lignin biodegradation. The project involves fungal and bacterial fermentation for a variety of potential applications in the pulp processing and residue treatment fields.

The project requires engineering expertise for enzyme production, fermentation, kinetics and scale-up.

The ideal candidate will have a Ph.D. in biochemical engineering, will have sound knowledge of biological systems, and some industrial experience in fermentation and enzyme production. Experience in the pulp and paper industry would be an asset.

This position should be of particular interest to Canadians studying or working abroad. Non-Canadians must satisfy Immigration Canada requirements.

To apply, please submit a concise résumé to:

The Personnel Administrator
THE PULP AND PAPER RESEARCH INSTITUTE
OF CANADA
570 St. John's Boulevard
Pointe-Claire (Québec) Canada
H9R 3J9

UNIVERSITY OF LIVERPOOL

'New Blood'

LECTURESHIP IN VETERINARY ANATOMY

Applications are invited for the post of Lecturer in the Department of Veterinary Anatomy, established under the UGC 'New Blood' initiative and tenable from 1 October, 1985. Candidates should normally be aged 35 or under on appointment. Persons holding permanent university appointments in the UK of whatever kind, are ineligible for appointment to this post. 'New Blood' appointments will be primarily for research. This post will reinforce and complement existing departmental research in neuromorphology. Applicants must be postdoctoral and have experience of immunohistochemistry of peptidergic nerves in normal or pathological tissues. A practical knowledge of tracing techniques and electron microscopy would be an advantage.

Initial salary within the range £7520-£12 635 pa on a scale rising to £14 925 pa.

Applications, together with the names of three referees, should be received not later than 22 April, 1985 by the Registrar, The University, PO Box 147, Liverpool L69 3BX, from whom further particulars may be obtained.

Quote Ref: RV/863 (e).

DEVON PROBATION SERVICE STATISTICS AND COMPUTER DEVELOPMENT OFFICER

Applications are invited from those with Higher National Diploma or higher qualification in computer science, mathematics, statistics or related subjects for this new post which will be based in the Headquarters office in Exeter.

The person appointed will be responsible for development and maintenance of statistical systems on microcomputer and will assist in the induction of staff in the use of microcomputers and advise on the wider applications of technology to the Probation Service's practical and information needs.

Salary will be on Local Authority Scales 4/5 (£6555 to £2622 pa).

Application form and job description are available from Miss M. E. Pest, Administrative Officer, Devon Probation Service, Second Floor, Queen's House, Little Queen Street, Exeter EX4 3JA on receipt of a cc. Closing date 30 April 1985 and interviews will take place on 9 May, 1985.

UNIVERSITY OF DUNDEE

Department of Biological Sciences POSTDOCTORAL RESEARCH ASSISTANTSHIP

Applications are invited for the post of Postdoctoral Research Assistant for a period of two years in the Department of Biological Sciences.

A protein chemist with interest and experience in growth factors and receptors will join a small, lively group directed by Drs Jahoda and Oliver investigating control of cell proliferation in skin and skin appendages.

The salary will be in the range 1A (£6600-£8920 per annum). Placing will be dependent on qualifications, age and experience.

Enquiries can be made to Dr C. A. B. Jahoda (0382-23181, Ext 4260).

Applications containing a full curriculum vitae and the names and addresses of three referees should be sent as soon as possible to the Personnel Officer, The University, Dundee DD1 4HN. Please quote Ref: EST/85/BSH.

As part of VG Instruments PLC, we are world leaders in both the manufacture and sales of specialist surface analytical and electron microscope instrumentation. Our export achievements have been acknowledged with three Queens Awards. 80 percent of our product range goes to foreign markets including USA, Japan, China, Europe and USSR. Based in rural west Sussex, only 30 miles from London, we have the following immediate openings:-

Software Engineers

An individual with an impressive track record, and initiative, is needed who can demonstrate experience in the following:

- Real time control applications using a PDP11
- Architecture of PDP 11 interfaces
- RT-11 and Macro 11
- Pascal and/or Fortran

There are also openings for Engineers with experience of Multitasking systems such as RSX 11, TSX and Micropower Pascal. An appreciation of data reduction techniques in surface science (or other) spectroscopies and proven ability in numerical methods would be an advantage.

Other openings exist for Engineers with experience of Pascal, 6502 Assembler or 8088 Assembler to work on Apple 11E and IBM PC.

Senior Physicists

Imaginative Physicists are needed to develop new instrumentation. A degree in physics or engineering is essential and several years involvement with the design of electron or ion optical devices is desirable. Experience in the fields of electron microscopy or surface analysis could be a definite advantage, as would an ability to generate new concepts and turn them into a physical reality.

Circuit Design Engineers

Engineers are required to design and develop the electronic content of a new range of scientific instruments. In addition to possessing the various design skills that would enable them to generate high quality circuitry, applicants will need to demonstrate an appreciation of the fundamental physical principles behind this state-of-the-art equipment.

The successful candidates, who will necessarily be versatile individuals and probably have a degree or the equivalent in electronics, will find their new environment stimulating and their further prospects excellent. Previous experience with scanning and display systems, high voltage generation or power supplies would be very appropriate and experience with digital techniques would be an excellent additional qualification.

Test/Development Engineers

To work on surface analysis instrumentation (XPS, AES, SIMS) and/or scanning electron microscope systems. Experience of UHV techniques and electronic fault finding would be an advantage.

Successful applicants will be required to spend some time travelling both in the UK and abroad (typically for 2-3 week periods).

Technical Sales Engineer – Electronic Microscopy

We need to recruit an experienced electronic microscopist to provide technical sales support worldwide for our increasing range of electronic microscopes. The applicant should be familiar with TEM, STEM and SEM systems and should be experienced in analytical microscopy.

The job involves on-site technical discussions with prospective customers, the presentation of papers at seminars and conferences and assistance with the preparation of appropriate literature.

An attractive remuneration package, a company car and assistance with relocation are available.

We offer a competitive salary plus an impressive list of company benefits which includes: sickness and pension scheme, free life assurance, five weeks holiday (increasing), and relocation expenses will be met where necessary.

VG SCIENTIFIC

The surface science and microscope company



Contact Mrs. Rosemary Wiseman now on:
(0342) 27211

Alternatively write immediately enclosing full
C.V. to: VG Scientific Ltd.,

The Birches Industrial Estate, Imberhome
Lane, East Grinstead, Sussex, RH19 1UB.

newscientist

We need a Sub Editor to work with the Features Editor of New Scientist. If you would like to work for the world's best science magazine and can attend to the detail of editing and processing articles, write and tell us why we should interview you. The sort of person we want probably has a science degree and perhaps some experience in editing.

Salary in line with NUJ agreement.

Applicants should write to—

Michael Kenward, Editor, New Scientist,
Commonwealth House, 1-19 New Oxford Street,
London WC1A 1NG.

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MRC CLINICAL RESEARCH CENTRE
(NORTHWICK PARK HOSPITAL)
WATFORD ROAD, HARROW
MIDDLESEX HA1 3UJ



POSTDOCTORAL BIOCHEMIST

Applications are invited for a Postdoctoral Scientific appointment in the division of comparative medicine. A Biochemist is required to join a team currently studying the role of free radicals in ischaemia of tissues and solid organs. Preference will be given to applicants with post-graduate experience of free radical chemistry, fluorimetry and high pressure liquid chromatography.

This is a short term appointment of three years with a salary within the range £10 153–£16 158 (inclusive of London allowances).

Informal enquiries may be made to Dr C. J. Green on 01-864 5311 Ext 2511. Application forms and further details may be obtained by writing to Miss S. A. Shaw, Personnel section quoting reference 102/1/3897.

Closing date for applications 18 April, 1985.

Clinical Research Scientist

Smith Kline & French Research need an additional Clinical Research Scientist to work with Research Physicians within Clinical Research & Development.

The work involves the evaluation of potential new medicines, initially in healthy subjects and subsequently in patients where a compound proceeds to the clinical trials stage. Duties include helping initiate and monitor studies and to evaluate and report the results.

Applicants should be graduates in one of the biological sciences. A PhD with relevant experience in the Pharmaceutical Industry or in Clinical Pharmacology would be an advantage. The ability to work within a small team and to communicate effectively both in writing and orally are essential.

We pay competitive salaries and provide a good range of benefits, which include a company car for this post.

Please send a detailed cv outlining your qualifications and experience, quoting reference number NS/114/PJB to Penelope Bucknell, Personnel Officer, Smith Kline and French Research Limited, The Frythe, Welwyn, Herts AL6 9AR.



ROYAL POSTGRADUATE MEDICAL SCHOOL (University of London)

RESEARCH ASSISTANT
Applications are invited for the post of Research Assistant at the Royal Postgraduate Medical School. The graduate will join Professor Stephen Bloom's team investigating the role of neural regulatory peptides. This expanding project is to unravel basic physiology of an important aspect of human control and use it to explore the aetiology of several human diseases in an attempt to provide new treatment. Experience in radiimmunoassay could be advantageous.

Salary will be in the range £6358 to £7106 depending on experience.

Send full cv to Personnel Office, Royal Postgraduate Medical School, 150 Du Cane Road, London W12 0HS quoting ref 2/S/RH.
Closing Date: 11 April, 1985.

KING'S COLLEGE LONDON PHARMACOLOGY TECHNICIAN

For teaching and research. Candidates should have relevant qualifications, at least ONC or equivalent, and 3-5 years experience in Pharmacology and/or related Biological Sciences. 37 hour week Monday - Friday. Contributory Superannuation Scheme. Five weeks annual holiday, plus six additional days when the College is closed at Easter and Christmas.

Salary on Grade 3 scale rising from £6649 pa-£7575 pa. (inclusive). Season ticket loan.
Apply in writing, with full details, to: Mrs A. Phillips (ref: 27005) King's College, London, Strand, London WC2R 2LS.

LEO LABORATORIES LIMITED

ASSISTANT MEDICAL INFORMATION OFFICER

Due to promotion an opportunity has arisen in the Medical Department of Leo Laboratories Limited, an international pharmaceutical Company, for an Assistant Medical Information Officer.

The duties will include answering enquiries, both oral and written, on the Company's products and areas of therapeutic interest; monitoring journals and maintaining an Adverse Drug Reaction Register.

Graduates in Pharmacy or with a Biological Sciences Degree, which must include at least one of the following -

- Pharmacology
- Human Physiology
- Microbiology and Biochemistry

and preferably with experience in medical information, should apply in writing giving a brief cv. to:

The Personnel Director, LEO LABORATORIES LIMITED, Longwick Road, Princes Risborough, Aylesbury, Bucks HP1 9RR.

Alternatively telephone now for an application form to Princes Risborough 0844-44 7333 asking for the Personnel Department.

Previous applicants need not re-apply since they will automatically be reconsidered.

Closing date for applications 11th April 1985.



UNIVERSITY OF SURREY Department of Materials Science and Engineering

'NEW BLOOD' LECTURER

There is a vacancy in the Department of Materials Science and Engineering for a NEW BLOOD Lecturer to develop existing work on the Rapid Solidification Processing of Metallic Materials. Particular emphasis is to be placed on the creation of novel structures by the consolidation of atomised metal powders using a number of fabrication routes.

The successful candidate is expected to have a materials science background with prior experience relevant to rapid solidification or powder metallurgy and a strong research record.

The post is tenable from 1 August, 1985 and applicants should normally be under the age of 35 years. The post is not open to persons holding a permanent university appointment in the United Kingdom, of whatever kind.

The salary will be within the Lecturer scale, £15500-£14 925 pa, according to age, qualifications and experience.

Further particulars are available from the Academic Registrar (AA), University of Surrey, Guildford, Surrey GU2 5XH, or Tel Guildford (0483) 571281, Ext 633. Applications from men and women, in the form of a curriculum vitae, including the names and addresses of three referees, should be sent to the same address by 26 April, 1985 quoting the reference 368/NB.

ASTON UNIVERSITY

Department of Molecular Sciences

CONTRACT RESEARCH ASSISTANT/OFFICER IN BIOCHEMISTRY/ ENDOCRINOLOGY

A challenging research position exists for an experienced graduate (contract research assistant level) or a qualified postdoctoral scientist (contract research officer level) to join a research group investigating hormonal aspects of diabetes mellitus. The appointee will engage in a study of the interaction between biguanides and insulin.

The post is for one year in the first instance with probable renewal for a further one or two years. Commencing salary will be made on either salary range 1B (for contract research assistant level) or salary range 1A (for contract research officer level)—£6600 to £8920 pa depending upon qualifications, age and experience.

Application forms and further particulars may be obtained from the Personnel Officer (academic staff), quoting ref: 675/32, Aston University, Aston Triangle, Birmingham B4 7ET. Tel 021 359 3811, Ext 4563. Closing date for the receipt of applications is 19 April, 1985.

UNIVERSITY OF CAMBRIDGE

Scott Polar Research Institute

UGC "New Blood" Post

REMOTE SENSING

Applications are invited from suitably qualified persons to take up an appointment as a New Blood Assistant Lecturer in Remote Sensing in the Senior Assistant in Research in the above field from 1 October, 1985. Preference will be given to candidates with interests in glaciology and/or polar oceanography. The Department supports an active research group working closely with the European Space Agency.

Further details from Secretary of Appointments, Cambridge University, Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER to whom applications in curriculum vitae and names of three referees should be sent by 17 May, 1985.

SENIOR ENVIRONMENTAL SCIENTIST



BP Petroleum Development (North West Europe) has a team, based in Aberdeen, which co-ordinates the environmental affairs of the Company's activities within the UK.

The brief of the Environmental Services Branch is to help local management achieve a high level of environmental awareness and protection within their own area of responsibility.

A Senior Environmental Scientist is required to formulate and implement environmental monitoring (terrestrial, aquatic and atmospheric) and auditing of the Company's operations. Reporting to the Environmental Services Manager, the successful candidate will also initiate environmental research projects and will advise management of technical and legislative developments concerned with

environmental protection. The task will require frequent consultation with company personnel, statutory bodies and environmental groups.

The post demands a good first degree and PhD. In a biological or environmental science and at least seven years practical experience of environmental protection work, preferably within an industrial context. Good communication skills are essential.

An excellent salary is offered together with international oil company benefits including a non-contributory pension scheme, sports/social facilities on site, free restaurant and relocation assistance, where appropriate, to one of the most attractive areas of Scotland.

Please write or telephone for an application form, quoting ref. AQ/190 to:

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MEDICAL RESEARCH COUNCIL

Anatomical Neuropharmacology Unit, Oxford

Applications are invited for the following posts in the newly established Unit, (Hon Director A. David Smith, Assoc Director Peter Somogyi).

Technician (Grade 6)

A personal research technician to work directly with the Associate Director, mainly using light and electron microscopic methods to study the brain. Several years experience of biological work is required.

Photography/Electronmicroscopy Technician (Grade 5)

This person will be required to carry out all photographic work for members of the Unit to publication standard and also to maintain the electron microscope and associated facilities. Considerable photographic experience is essential.

Applicants should have the appropriate educational experience. Remuneration for each post will be at an appropriate point on the scales for University non-academic staff. Each post is tenable for five years at this stage. Further information may be obtained from Professor A. David Smith or Dr Peter Somogyi, MRC Unit, Department of Pharmacology, South Parks Road, OXFORD OX1 3QT (Telephone Number Oxford 518271), with whom applications—including a full CV and the names of two professional referees—should be lodged by 1 May, 1985.

TOPEXPRESS LIMITED, CAMBRIDGE

Research Scientists

We require research scientists to join a newly formed team of mathematicians and engineers who are developing novel systems for the active control of noise and vibration. This research and development programme is aimed at improving the understanding of the fundamental limitation on such control systems and designing them to approach those limits in practice.

Candidates for this position must be bright and enterprising, and able to organise their own research in useful directions. A first class science degree is essential, together with either a PhD or at least three years experience in acoustics, control or related fields.

Topexpress, a scientific consultancy, has been established for six years and now employs some thirty scientists working on long-term research projects. Other work in the company includes signal processing, structural acoustics, aeroacoustics and other wave phenomena studies. We provide an informal working environment in central Cambridge and we encourage publication of research findings. We offer an attractive salary and a range of benefits including a share of the company profits.

If you are interested please write with a curriculum vitae and the names of two referees to Colin Ross, Topexpress Limited, 13/14 Round Church Street, Cambridge CB5 8AD.



Department of Ship Science

Applications are invited for the post of Manager of the Wulston Marine Technology and Industrial Aerodynamics Unit in the Department of Ship Science. The Unit was established in 1968 and is financially self supporting, offering research and development services to industry on a repayment basis. Applicants should be aged 40-50 with engineering project management experience in industry, preferably with a good degree in Engineering or Naval Architecture.

Salary will be in the range £14 135-£17 705 per annum (under review).

Further details from Professor G. J. Goodrich, Ship Science Department.

Applications with curriculum vitae and the names of two referees to Dr. A. S. Cockland, Staffing Department, University of Southampton, Highfield, Southampton SO9 5NH, by 15 April, 1985, quoting reference number 2140.

Scientists for Neutron Scattering

The intense pulsed neutron source, SNS, will operate at the Rutherford Appleton Laboratory from May 1985. This exciting development will provide a neutron source of world significance to further University research in the fields of physics, chemistry, biology and materials science.

A number of the SNS instruments are concerned with neutron diffraction from powders, liquids, amorphous and single crystal samples. The Laboratory wishes to recruit scientists to have responsibility for instrument operation, design and development in these areas and to pursue related scientific programmes of research. Experience in X-ray or neutron scattering, crystallography or in a closely related field would be an asset but not essential. All candidates should have computing experience and have demonstrated their research capabilities.

Appointments will be made in the Higher Scientific Officer or Research Associate grades at levels dependent on qualifications and experience.

Salaries will be:

Higher Scientific Officer £7435-£10039

Research Associate £7334-£11229

(fixed three year term)

Candidates should have a degree, HNC/HND or equivalent in scientific or mathematical subjects, plus at least 2 years post graduate research or development experience for applicants with 1st or 2nd class honours degrees or equivalent qualifications.

Other applicants are required to have 5 years of appropriate scientific experience after qualifying.

The Laboratory is a friendly community with its own restaurant and sports facilities nearby. Benefits include a local transport service and generous holidays.

Application forms from: Recruitment Office, RAL, Science and Engineering Research Council, Chilton, Didcot, Oxon, OX11 0QX. Tel: Abingdon (0235) 445435 quoting ref VN327

Closing date: 19th April 1985



Rutherford Appleton Laboratory

THE UNIVERSITY OF MANCHESTER

LECTURER IN CLINICAL PHARMACOKINETICS IN THE DEPARTMENT OF PHARMACY

Applications are invited for this post under the national scheme to encourage the appointment of younger members of the academic staff (the 'new blood' scheme). Applicants should normally be under the age of 36. This post offers an exciting opportunity for a young investigator to make contributions in the newly emerging area of clinical pharmacokinetics. We seek to attract a PhD graduate in the pharmaceutical, chemical or biochemical sciences. Experience in clinical investigation is desirable. The successful candidate will be expected to initiate original research and to collaborate with Department of Pharmacy academic staff, with members of the Clinical Pharmacy Practice Group and with investigators in various clinical departments. Teaching will be in the areas of pharmacokinetics and pharmaceutical analysis. The Department is recognised internationally as a centre for teaching and research in pharmacokinetics. Excellent links with various clinical departments and with the pharmaceutical industry exist. To facilitate clinical developments, a Clinical Pharmacokinetic Research Laboratory is to be established at Hope Hospital, one of the University Teaching Hospitals, where the successful applicant will work predominantly. Salary range pa: £7520-£14 925. Superannuation. Informal enquiries may be directed to Professor M. Rowland, Department of Pharmacy (061-273-7121, Ext 5181). Particulars and application forms (returnable by 26 April) from the Registrar, The University, Manchester M13 9PL. Quote ref 63/85/NE.

We are the UK subsidiary of the international Upjohn Pharmaceutical Organisation. Our Quality Control Division currently has a vacancy for an

Analyst

Duties include the analysis of raw materials and finished products using both classical analytical and modern chromatographic techniques. Candidates should be new or recent BSc graduates in a chemistry or related discipline with up to three years relevant experience.

We offer a competitive salary and benefits package together with pleasant working conditions in well-equipped laboratories.

Please apply to: Mrs Pamela Gelder, Personnel Coordinator, UPJOHN LIMITED, Fleming Way, CRAWLEY, West Sussex. Tel: (0293) 589227.

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KING'S COLLEGE HOSPITAL

MOLECULAR BIOLOGIST/ BIOCHEMIST

Department of Haematology, Prenatal Diagnosis Unit

Graduate invited to join active department developing DNA techniques in prenatal diagnosis of serious blood diseases. The post is OHSS funded with an established science commitment in Haematology, Obstetrics and Fetal Medicine. There is wide scope for research in an expanding clinical genetics field with newly completed laboratories. The position is available now, but applicants who can only start in summer will be considered. Salary and grade according to qualifications.

Further details from Dr R. S. Mbeahen, Department of Haematology, Tel 01-274 8222, Ext 2519. Applications in the form of curriculum vitae (which must include the names of three referees) should be sent to the Unit Personnel Department, King's College Hospital, Denmark Hill, London SE5 8RS.

Closing date: 18 April 1985.

THE UNIVERSITY OF LEEDS

DEPARTMENT OF CARDIOVASCULAR STUDIES

"NEW BLOOD" LECTURER

Applications are invited from medical or non-medical graduates with a higher degree for the above post which has been created under the UGC's New Blood Scheme and available from 1 September 1985. The successful appointee will research in the neuroendocrine field of cardiovascular regulatory peptides in close collaboration with, and support of, the Neuroendocrinology Unit, Newcastle Prof. J. Edvardsson. Neuroendocrinological experience in, for example, CC, radioimmunoassay, two site recognition immunoradiometric assay or receptor binding techniques would be an advantage. Teaching in undergraduate and postgraduate areas is available.

Salary on the non-clinical scale for Lecturers (£7520-£14 925) (under review) according to age, qualifications and experience.

The age limit for these posts is 35 but marginal exceptions may be made.

Visits to the Department may be made by arrangement with Professor R. J. Lennox, Department of Cardiovascular Studies, (Tel. 0532 431751 Ext 7157 or 7158).

Application forms and further particulars may be obtained from the Registrar, The University, Leeds LS2 9JT. Quoting reference number 105/28. Closing date for applications 2 May, 1985.

UNIVERSITY OF SURREY

Department of Mechanical Engineering

RESEARCH FELLOW

A Research Fellow is required to conduct theoretical and experimental studies of a pneumatic compliant sensor for low-cost robot assembly tasks under an SERC grant. The candidate should be familiar with computing techniques and have some experience of experimental work using data acquisition electronic equipment.

The post is for one year and the successful candidate will be employed on the Research and Analogous Scale, Grade IA in the range £7520-£8690 pa depending on age, qualifications and experience. Superannuation under USB conditions.

Further details may be obtained from Professor G. A. Parker on 0483 571281, Ext 445. Applications in the form of a cv (three copies) including the names and addresses of two referees should be sent to the Personnel Office (J/01), University of Surrey, Guildford, Surrey GU2 5XH by 12 April, 1985, quoting reference 376/NE.

UNIVERSITY OF WARWICK

Department of Engineering

Applications are invited for a

'NEW BLOOD' LECTURESHIP

In Precision Engineering, in the Department of Engineering within the Centre for Manufacturing and Metrology, which has attracted over £1m in external funding from SERC, DTI and industry. The post is intended to strengthen expertise in the fields of optics and/or fine mechanics; applicants should have a good record of research in these or an allied field such as experimental physics. Candidates should normally be age 35 or under.

Salary will be on the Lecturer scale in the range £7520 to £14 925 (under review). Informal enquiries may be made to Professor D. J. Whitehouse or Dr D. J. Brown in the Department of Engineering (0930 26011, Ext 2133). Further details and application forms may be obtained from the Registrar, University of Warwick, Coventry CV4 7AL quoting Reference No. NB/3/85/P. The closing date is 26 April, 1985.

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Candidates, male/female, ideally in their late twenties, early thirties, should possess a good degree in Physics, Physical Chemistry or Chemistry; have an interest in instrumentation and a knowledge of electronics combined with some software. Whilst a PhD and some years experience in product development in either a research or industrial post is preferred, candidates with limited experience who believe they have the ability and flair to succeed in this role should not be inhibited from applying. Rapid career development for successful candidates is likely.

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Research Statistician

You will review and develop statistical methods and programmes for research applications, train scientists in statistical methods, and co-ordinate liaison with our Biostatistics unit in the USA.

We shall be interested if you have a degree or post-graduate qualification in statistics or MIS plus two to three years' experience, preferably in pharmaceuticals or a related industry, and are keen to

develop and use computer based applications.

Research Applications Programmer/Analyst

Your role will involve developing applications, scientific programs, management information systems and utilities to support research activities. You will also train research computer users and develop systems for automated transfer of data from laboratory instruments to mainframe computers. The range of computing services you will use includes a leased data circuit to IBM mainframes in the USA, micros and other advanced tools including SAS, TELLAGRAF and SQL/DS.

You will have a relevant computing qualification or two/three years' experience in an IBM mainframe or scientific computing environment and be conversant with relational database design. Knowledge of FORTRAN and/or PL/I would be useful.

Both appointments carry a competitive salary and benefits package, in addition to which we can provide the pleasant, well equipped working environment which reflects our concern for people as individuals

Please send details of your qualifications and experience to Pamela Gelder, our Personnel Co-ordinator, or telephone her on Crawley (0293) 589227 for an application form. Upjohn Limited, Fleming Way, Crawley, West Sussex

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ENGINEER A FUTURE FOR YOURSELF IN BRISTOL

Central to almost all of the activities carried out at British Aerospace Dynamics Group, Bristol Division, is our involvement with the very latest developments in electronics and its associated technologies. Extensive design and manufacturing facilities exist for the development and production of all types of circuitry from dc to infra-red, with particular emphasis on digital computing.

Communications analysis is another speciality, particularly system availability, traffic loading and network analysis of communications systems.

Great emphasis is placed on countermeasures to provide an effective defence against today's sophisticated weapons. One team is devoted to both electronic warfare systems analysis and IR countermeasures where jamming and decoy techniques for use against homing weapons are evolved. Electromagnetic environment simulators are also designed and built for use as development tools and as operational trainers.

So you see, we are not just another weapons manufacturer but also a source of some of the most advanced developments in electronics to be found anywhere in the world.

If you would like to play an active part in helping us maintain our position at the forefront of the electronics industry, you should be qualified to HNC/HND/degree level or above in a relevant subject and have at least two years experience in any of the following areas:-

Electronic Digital Design Systems
Microwave/millimetric design
Software development & Support

Mathematical Modelling
Electro-optical design
Image/Signal processing
ATE applications

In the first instance, please forward a career resume, or telephone for an application form, making sure that you quote the reference number, to Trevor Mason, Ref: 461/TWM, Engineering Recruitment Office, FPC 104, British Aerospace PLC, Dynamics Group, FREEPOST (BS 3666), Bristol BS12 7BR. No stamp required. Tel: FREEFONE 9918 Ext. 3188.

Hampstead Health Authority
Royal Free Hospital
Medical Physics Department

Electronics Technician

Salary: Grade II: £8802-£10 711
Grade III: £7492-£9367

A Senior Technician is required to join a team looking after a wide range of sophisticated medical equipment at this modern hospital near Hampstead Heath.

The post offers an excellent opportunity to gain experience on equipment such as linear accelerators and computer controlled radiotherapy machines etc. A good knowledge of electronics is essential and an HNC or A level or equivalent qualification and three years experience is needed for the Grade II post.

Experience with the above equipment is not necessary as training will be given.

For job description and application form please contact the Personnel Department, Royal Free Hospital, Hampstead, London NW3. Telephone 01 794 0500 ext 4286.

Closing date: 11 April, 1985.

INSTITUTE OF CANCER RESEARCH JUNIOR TECHNICIAN

is required for the Institute's Electron Microscopy Unit, Chester Beatty Laboratories, Fulham Road, London, SW3. Candidates should have either four 'O' levels in Biology, another science subject, English Language and Maths, or two 'A' levels in Biology and another related subject. The job is interesting and varied and the successful candidate will be instructed in the various techniques of electron microscopy from tissue processing and sectioning to examination photography and printing. Day release to study for appropriate technical qualifications will be available. Salary depending on age and qualifications in range £3718-£5055 pa plus London Allowance of £1042 pa.

Applicants are advised that in the majority of the Institute's premises smoking is prohibited.

Applications in duplicate with the names of two referees to the Personnel Officer, Institute of Cancer Research, 17A Onslow Gardens, London SW7 3AL, quoting Ref 301/B/80.

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to run a small busy Department. Work includes echocardiography, temporary pacing, stress testing and 24 hour tapes. Car driver preferred but not essential. Salary £8660-£8178 inclusive of London Weighting.

Application forms and job description available from Personnel Department, Barnet General Hospital, Wilford Lane, Barnet, Herts or phone 01-440 5111, Ext 450.

Applications to be returned as soon as possible.

UNIVERSITY OF BRADFORD TEMPORARY LECTURESHIP IN PHARMACOLOGY

Applications are invited for the above post which is currently vacant and available until 31 July 1988. The appointee will be required to teach and research in the general area of Pharmacology. Preference will be given to candidates with expertise in the area of Autonomic Pharmacology. Salary on scale £7520-£14 925 pa. Further particulars and application form from the Deputy Secretary, (Ref TL/Pg/NS), University of Bradford, West Yorkshire BD7 1DP. Applications to be returned asap.

THE ECO PARTNERSHIP ENERGY CONSULTANTS

The ECO Partnership is a rapidly growing energy consultants group with advice to UK Government, Local Authorities etc. as well as designing low energy houses, factories and schools and carrying out energy surveys. We seek a SENIOR CONSULTANT aged 30-40 to take charge of the group and a GRADUATE CONSULTANT 25-30 to assist. Both posts need a physics degree and further energy qualifications and experience. Please write with CV or photo.

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The ECO Partnership
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To participate in the development of a near-micron integrated circuit fabrication process. You will need a Degree or equivalent in electrical engineering or applied physics, plus a minimum of 3 years' experience in lithography and automated wafer handling.

Our client's leadership in high technology provides a superb environment for the creative engineering skills of the most proficient semiconductor technologists in the world.

And, while Canada is the ideal setting for further technological advancement in the future, it is also a magnificent country in which to live, with one of the highest standards of living anywhere in the world, and many close cultural links with Great Britain.

Outstanding salaries and benefits are part of the exceptional remuneration packages offered by our client. You'll also receive comprehensive relocation assistance and guidance on travel procedures for you and your family.

A rewarding career right at the forefront of semiconductor technology, and the start of a great new life in Canada. That's our client's offer to the UK's best, so please write, enclosing a full cv, to find out more from L. Noad at Moxon Dolphin & Kerby, 178-202 Great Portland Street, London W1N 5TB quoting reference number 3190/N.S. or telephone her on 01-631 4411.

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UNIVERSITY OF KENT at Canterbury

RESEARCH FELLOW IN PHYSICS

Applications are invited for appointment to the post of Research Fellow to work with Professor J. G. Powles on the theory of liquids, preferably including some computer simulation. The project is supported by the Science and Engineering Research Council and the post is available immediately. This appointment will be for a period of one year and four months and the salary will be in the range of £7620-£7880. Application forms and particulars may be obtained from the Assistant Registrar, Faculty of Natural Sciences, Chemical Laboratory, The University, Canterbury, Kent CT2 7NH, to whom completed applications should be submitted by 19 April, 1985. Please quote reference A23/85/NS.

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International consultants in water resource development and management

As a result of an expanding workload in the Middle East and Africa we require the following staff:

Project Manager
background in groundwater resources assessment, development and management. 12 years' experience.

Senior hydrogeologist
experience of groundwater resource assessment. Minimum age 25.

Groundwater geophysicist
experience with a wide range of geophysical techniques into groundwater resource investigation. Minimum age 25.

We are looking for people who are highly motivated and good communicators. Experience in report writing essential. We are offering competitive salary and good working conditions.

Please write with detailed curriculum vitae to Mrs D. J. Morrey.

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HERIOT-WATT UNIVERSITY

INSTITUTE OF OFFSHORE ENGINEERING

Institute Biologist

The Biology Section of the Institute requires young graduates to join a team involved in an expanding research and contract programme of Marine Benthic Studies. The applicant should preferably have an interest in Invertebrate Taxonomy as the post involves initially a large amount of taxonomic work. Previous experience in Invertebrate Taxonomy is desirable but not essential. The post will be for one year in the first instance.

Employment terms are negotiable, but likely to be on a University Scale £6600-£8920.

Application forms are available by writing to the Staff Officer, Heriot-Watt University, Chambers Street, Edinburgh EH1 1HX, quoting Ref No 25/85, to whom completed applications should be returned by 19 April, 1985.

PHYSICIST

— Flow Sensor Development GLOUCESTERSHIRE

Kent Industrial Measurements Limited, Flow Products are manufacturers of flow measuring instruments for industry and the public utilities. We have modern premises near to Stroud, Gloucestershire which were built specifically for the manufacture and design of flow metering devices.

This modern unit has one of the largest and most advanced flow test plants in Europe together with laboratories to support applied research activities.

We now require an enthusiastic Physicist or Engineer who is able to contribute to the development of novel flow measuring instruments. You will be part of a multi-disciplinary team and participate in the running of one or more applied research programmes. The work will require an understanding of the flow of liquids and gases and will be related to the design, testing and introduction to manufacture of the devices.

Our Personnel Manager, Mike Hopkins, will be pleased to hear from graduate engineers (male or female) with at least 2 years' relevant experience. Starting salary will be commensurate with experience and generous benefits include re-location expenses where appropriate.

For more information phone Stonehouse (045 382) 6661 or write for an application form to: The Personnel Department, Kent Industrial Measurements Limited, Flow Products, Oldends Lane, Stonehouse, Glos. GL10 3TA.

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UNIVERSITY OF BRISTOL AND WARREN SPRING LABORATORY

Bacterial Flocculation POSTDOCTORAL RESEARCH ASSOCIATE

Flocculation is a widely used method for large-scale bio-separation. In order to establish optimum conditions, it is necessary to understand the mechanisms involved. This project is concerned with bacterial flocculation and, in particular, the role played by the polymers present in the outer layers of the bacterial cell walls. The work will involve the isolation and characterisation of these polymers, in solution and adsorbed on model colloidal particles. The intention is also to mimic the flocculation behaviour of bacteria using these model systems. Modern spectroscopic techniques, such as pulsed n.m.r. and photon correlation light scattering, will be used to study the adsorbed polymer molecules.

The project will be for one year in the first instance (with the probable renewal for a second year), starting on or after 1 June 1985. It will be carried out jointly in the Department of Microbiology (Dr R. C. W. Berkeley) and Physical Chemistry (Drs B. Vincent and T. Cosgrove) at the University, and also in close collaboration with the Department of Trade and Industry, Warren Spring Laboratory (Drs M. Sutton and C. Bowden), which is funding the work as one of its EMRA projects. Starting salary will be at suitable point on the University IA scale (range £7520 to £12 150), depending on age and experience.

Applicants should apply to Dr B. Vincent, Dept. of Physical Chemistry, University of Bristol, Bristol BS8 1TS, as soon as possible. Names and addresses of two referees should be included.

UNIVERSITY OF EDINBURGH

'New Blood' Lectureship in Biochemistry

Applications are invited for the above appointment which will be made in the field of structural biochemistry. It is proposed to appoint a candidate with research and teaching interests in non-crystallographic structural studies, x-ray diffraction or solution scattering using physical techniques such as X-ray scattering, neutron scattering or photon correlation spectroscopy. Marginal preference may be given to applicants wishing to work on topics such as extra-cellular matrix components, enveloped viruses or muscle but more original fields of interest would be most welcome.

The Department of biochemistry occupies a new building well equipped for structural studies and associated computing, and the 'New Blood' Lecturer would have the opportunity to help develop this new line in the Department.

Salary will be on the scale £7520-£14 925 pa, with placement depending upon age, qualifications, and experience. The upper age limit for appointment is 35, and persons holding a tenured University appointment in the UK are eligible.

Further particulars may be obtained from the Secretary to the University Old College, South Bridge, Edinburgh EH8 9YL, with whom applications (8 copies) giving the names of two referees, should be lodged not later than 18 April, 1985. Please quote Reference No H83.

RUBBER TECHNOLOGIST

A vacancy has arisen at MRPRA for a Technologist to join the Dry Rubber Group. This group undertakes a wide range of R and D Projects to further the use of NR and also responds to world wide technical enquiries from the rubber industry. In the first instance, the successful applicant will work on compound development for a new modification of NR now in pilot scale production but a readiness and ability to diversify into other project areas will be expected.

Applicants should be of degree standard in polymer science with some pre- or post-graduate experience in the rubber industry.

The Association is located in pleasant Hertfordshire countryside, 11 miles from the town centre. Realistic salary will be paid dependent on experience—contributory pension scheme.

Applications should be in writing, with cv, quoting Ref CHLB 10: The Director, Tun Abdul Razak Laboratory, The Malaysian Rubber Producers' Research Association, Brickendonbury, Hertford SG13 5NL.

UNIVERSITY OF LONDON INSTITUTE OF PSYCHIATRY Department of Biochemistry

MSO required to work on the effects of cholinergic agonists on presynaptic phosphatidylinositol metabolism and intracellular free calcium levels. Previous experience in neurochemistry, particularly techniques involving lipids, would be a considerable advantage. The post is grant-supported for approx two years five months. The appointment will be for one year in the first instance.

Whitley Council Salary and conditions of service in the range £5738-£6982 pa, plus £1042 pa London Weighting.

For application form, send stamped addressed envelope to the Assistant Secretary, Institute of Psychiatry, De Crespigny Park, Denmark Hill, London SE5 8AP (quoting Ref MR/NS). Closing date for applications: 12 April, 1985.

Could YOU teach craft design and technology?

Because of the need for secondary school teachers of this key subject, the Department of Education and Science and the Welsh Office will in 1985 again be offering special high-value training awards, tenable at short (one- or two-year) courses of initial teacher training or retraining in Craft Design and Technology (CDT).

If you are between 26 and 50, and have relevant technical qualifications (eg a degree or HND in engineering), or you are a qualified teacher wishing to retrain, send for the free booklet *Teacher Training Awards in CDT* to

Department of Education and Science
Information Division (2/11)
Elizabeth House, York Road, London SE1 7PH.

Senior Development Chemist Liquid Engineering for Marine Applications



You have doubtless seen our television campaign based on the 'liquid engineering' theme. As a result, most people associate Castrol products with motor cars. But, in fact, we are also very active in marine lubricants, with over 50 years' experience in this market and now need a Senior Development Chemist whose prime responsibility

£3500-£4500

will be the development of new marine lubricants.

The successful applicant would most likely be a graduate or equivalent in Chemistry or Engineering with experience in Chemistry, plus 8-10 years in a laboratory covering the development, technical service and analysis of lubricants or additives. Candidates should be conversant with the chemistry of additive technology applied to large diesel power units.

Candidates should be self motivated and be able to work effectively with people of all levels and disciplines. The job is based in Pangbourne, Berkshire and the excellent benefits package offers a non-contributory pension plan, free life assurance and relocation assistance, if appropriate.

Please send a detailed c.v. or telephone for an application form to: Miss H. Bowler, Castrol Limited, Castrol Research Laboratories, Whitchurch Hill, Pangbourne, Reading, Berks RG8 7QR. Tel. Pangbourne (07357) 4321.



UNIVERSITY OF LONDON Institute of Neurology RESEARCH TECHNICIAN

Applications are invited for the post of Research Technician (University Grade 5) to take part in a study of the development and localisation of cell surface antigens of human muscle in tissue culture. Practical experience in electron microscopy is essential, and some familiarity with immunocytochemical techniques an advantage.

The post funded by the Brain Research Trust is available immediately and is tenable until 30 September, 1986. Salary within the range £6640-£6951.

Applications accompanied by a full cv and the names and addresses of two referees, should be sent to Dr R. Yasin, Miriam Marks Department of Neurochemistry, Institute of Neurology, Queen Square, London WC1. For further information please Tel 01-637-3611, Ext 282.

UNIVERSITY OF CANTERBURY New Zealand LECTURER IN CHEMISTRY

Applications are invited for the above position in the Department of Chemistry. The appointment will be made either in organic chemistry or in physical chemistry.

The salary for Lecturers is on a scale from NZ\$21 600 to NZ\$25 684 pa. Further particulars and Conditions of Appointment may be obtained from The Association of Commonwealth Universities (Appl), 38 Gordon Square, London WC1H 0PF.

Applications close with the Registrar, University of Canterbury, Private Bag, Christchurch, New Zealand, on 31 May, 1985.

An opportunity in Applied Research Research Scientist

Up to £11,000 pa Crawley, West Sussex

Duracell are leaders in the dry cell battery field, both in terms of sales and research and development activities. We have recently opened a new Technical Centre and now wish to strengthen our Applied Research Team by appointing a Research Scientist.

You will be involved in research on new and existing electrochemical cells. Your research work will include fundamental studies of battery chemistry and be directed towards obtaining higher performance power sources.

We are looking for a Science Graduate with up to five years' experience in industrial or academic research. A background in electrode kinetics or in membrane technology would be an advantage. An enthusiasm for relating the results of basic research to practical technology is required.

We offer a range of large company benefits, including assistance with relocation, where appropriate.

For further details please telephone or write to Cathy Henderson, Personnel Officer, Duracell Batteries Limited, Mallory House, Gatwick Road, Crawley, West Sussex RH10 2QY. Tel: Crawley (0293) 580237.

DURACELL



THE BOWETT RESEARCH INSTITUTE Buckhorn, Aberdeen, AB9 9BB HEAD OF BIOMETRY DEPARTMENT

A senior biometrician is required as head of the Biometry Department in which it is essential for the statisticians to have the in-depth understanding of animal biological processes and the variations therein processed by the previous staff who were the leading statistical advisers involved in developing our current concepts of animal nutrient requirements.

The appointee's duties will include general supervision of the Department and overall responsibility for the mathematical, statistical, computing, and data presentation services that it supplies for the Institute. He/she should be able to provide active and innovative leadership, and be experienced in the application of mathematics to biological problems and in consultancy and collaboration with biologists. The Department operates a mini-computer (Prime 560) with distributed terminals and other peripherals.

Applicants should possess a good Honours degree in statistics, or mathematics with statistics, or similar qualification, and considerable relevant postgraduate experience. Salary will be in the grade of Principal Scientific Officer - £11 797 to £15 678 pa. There is a non-contributory Superannuation Scheme but 1% is contributed for dependent relatives. The Institute is an Equal Opportunity Employer. Further particulars are available from the Secretary of the Institute, to whom applications including the names of two referees, should be lodged by 18 April, 1985.

Analysts & Senior Analysts

Huntingdon Research Centre plc is Europe's largest contract organisation working in the safety evaluation of pharmaceuticals, pesticides and industrial chemicals. Our Department of Analytical Chemistry is very well equipped with modern instrumentation and carries out a wide range of analysis for compounds in biological materials and experimental formulations.

Due to continuing expansion of this important growth area, we are now seeking Analysts at all levels.

TRAINEE ANALYSTS with a degree or equivalent in Applied or Analytical Chemistry; previous industrial or research experience is not essential but preference will be given to candidates with work experience gained via sandwich courses.

ANALYSTS with a degree or equivalent in Applied or Analytical Chemistry with 2-3 years' experience

in the analysis of pharmaceuticals or pesticide residues, particularly by H.P.L.C. and G.L.C.

SENIOR ANALYSTS with a degree and further education in Applied or Analytical Chemistry together with 5-10 years' experience in the analysis of pharmaceutical/veterinary residues in biological fluids or pesticide residues in crops by H.P.L.C. or G.L.C. Experience of supervising a small analytical team would be an advantage.

Salaries are competitive and will be based on qualifications and experience. We offer assistance with relocation expenses where applicable. The Centre is situated near Huntingdon with good access to London by both road and rail.

Please send C.V. to the Personnel Officer, Huntingdon Research Centre plc, Huntingdon, Cambs. PE18 6ES. Tel: Huntingdon (0480) 890431 ext 3251.

**Huntingdon
Research Centre plc**

HRC

INSTITUTE OF CANCER RESEARCH

There is a vacancy for a **POST-DOCTORAL SCIENTIST** at the Institute's Chester Beatty Laboratories, Fulham Road, London SW3, to join the Drug Targeting Team. The Team is investigating the use of antibodies, especially monoclonal antibodies, as vehicles for the delivery of cytotoxic agents to specific target tissues. The Team's activities include the construction of semi-synthetic antibody-based conjugates, their evaluation as cytotoxins in appropriate in vitro systems and studies of their localising capacity in animal systems, including xenografted human tumours. The successful candidate will be asked to address particularly, problems related to the in vivo delivery of these agents, such as their stability in the milieu interieur and their mode of metabolism, with a view to optimising their molecular design. A pharmacological background would be appropriate but it is not a prerequisite. The appointment is for three years in the first instance. Salary, depending on previous experience will be in the range £8920-£11 205 pa plus London Allowance of £1233 pa. Applicants are advised that in the majority of the Institute's premises smoking is prohibited.

Applications in duplicate with the names of two referees should be sent to the Personnel Officer, Institute of Cancer Research, 17A Orono Gardens, London SW7 3AL, quoting ref. 300/G/9.

NORTHERN REGIONAL HEALTH AUTHORITY Regional Medical Physics Department

FREEMAN HOSPITAL UNIT

SENIOR COMPUTER SCIENTIST/PHYSICIST

Computing and electronics have a significant role to play in the care of patients within the Health Service. Our team is currently applying these techniques to a wide range of research and development problems. We are looking for a keen, enthusiastic person, with computing skills, who is eager to develop and widen their skills. We need someone to take responsibility for computer system management, and to co-ordinate computer planning and development.

We invite you to write or telephone for a job description, and telephone Dr A. Murray, who will answer any other questions you might have. We also encourage informal visits.

Applicants must possess a good honours degree in Computing Science, Electronic Engineering, Physics, or other appropriate subject, together with four years relevant experience. Exceptionally, outstanding candidates with less than four years relevant experience may be considered for initial appointment to a lower grade.

Salary scale £9415-£12 173 (a pay award is due w.e.f. 1 April, 1985).

Application form and job description from Regional Personnel Officer, NRHA, Walkergate, Newcastle upon Tyne NE6 4PY (Tel 091-2654 188 ext 3112), to discuss the post or arrange a visit contact Dr A. Murray, Head of Freeman Hospital Medical Physics Unit (091-2843111 ext 3449).

Closing date: 15 April, 1985.

THE CITY UNIVERSITY

Department of Systems Science LECTURESHIP IN SYSTEMS MANAGEMENT

Applications are invited for the post of Lecturer in Systems Management. Candidates should have a postgraduate qualification in a systems orientated discipline such as Systems Management, Systems Analysis or Systems Engineering. Professional management experience involving the application of the systems approach and practice will be an advantage.

The successful candidate will be required to contribute to the research and teaching programmes of the Department. The teaching required at both undergraduate and postgraduate levels will be in the area of Systems Management, developing courses in management problem-solving and decision-making in the context of soft systems and in computer-aided decision-making, together with an associated computer laboratory. It is expected that the research interests of the successful candidate will relate to Computer-Aided Interactive Management or Computer-Aided Medical Diagnosis and Patient Management.

This post is for five years in the first instance. Salary will be within the scale £8783 to £16 158 pa inclusive.

Application forms and further information may be obtained from the Academic Registrar's Office, the City University, Northampton Square, London EC1V 0HB. Tel 01-253 4399, Ext 3037. Closing date for applications 19 April, 1985.

UNIVERSITY OF EDINBURGH

Lecturer in Experimental Condensed Matter Physics

Applications are invited for a New Blood Lectureship in the Department of Physics to work in the area of Experimental Condensed Matter Physics. Preference will be given to applicants who will be able to cooperate with the present members of the condensed matter physics group, and extend the experimental work into the study of new materials, surfaces or low dimensional structures. Applicants should normally be less than 35, and have a proven ability for independent research. Persons holding permanent university appointments in the UK are ineligible. The salary will be on the Lecturer scale £7520-£14 925 pa, dependent upon age and experience. Applications (2 copies), including the names of two referees, should be sent before 12 May, 1985, to Professor R. A. Cowley, Department of Physics, University of Edinburgh, Mayfield Road, Edinburgh EH9 3JZ. From where further particulars can be obtained. Please quote reference no. N86.

RESEARCH ASSISTANT

required for a three year project using molecular biology to study cytoskeletal function. The successful candidate, who should have a relevant honours degree, will use antibodies in conjunction with cDNA expression libraries to identify and characterise cytoskeletal genes. Raising monoclonal antibodies is an additional, an integral, part of this work. Applicants should have previous laboratory experience of general biochemical techniques, preferably molecular biology, and an interest in cell biology/molecular genetics. Knowledge of tissue culture is unnecessary. Salary scale RA1B on scale £7980-£8820 pa+£1233 L.W. Applications inc cv and names and addresses of two referees to Dr D. Lawson, Zoology Department, University College London, Gower Street, London WC1E 6BT.

UNIVERSITY OF OXFORD

New blood Appointments in Science and Mathematics

Applications are invited for the following university lectureships tenable from 1 October, 1985. It is hoped that each of these appointments will be held in conjunction with college fellowships as indicated below. Further particulars of the university lectureships and of the relevant college appointments may be obtained from the person named below, to whom applications (on typed copies, or one from overseas applicants) should be sent. (Separate application is not necessary for the associated appointments.) The closing date for receipt of applications is 22 April, 1985.

ENGINEERING SCIENCE

Fluid Mechanics

St Catherine's College

Robotics

Brasenose College

(Professor C. P. Wroth, Department of Engineering Science, Parks Road, Oxford OX1 3PJ. Telephone Oxford (0865) 59988.)

MATHEMATICS

Numerical Analysis

Linacre College

(Professor K. W. Morton, Computing Laboratory (Numerical Analysis Group), 8-11 Kable Road, Oxford OX1 3QD. Telephone Oxford (0865) 54141.)

Algebra and Number Theory

Wolfson College

(Chairman of the Board of the Faculty of Mathematics, Mathematical Institute, 24-29 St Giles', Oxford OX1 3LB. Telephone Oxford (0865) 54295.)

MOLECULAR BIOPHYSICS

LABORATORY

Structural Molecular Biology

Hertford College

(Professor Sir David Phillips, FRS, Molecular Biophysics Laboratory, South Parks Road, Oxford OX1 3QU. Telephone Oxford (0865) 56733.)

UNIVERSITY OF GLASGOW

Department of Aeronautics and Fluid Mechanics

Applications are invited for a

NEW BLOOD LECTURESHIP

IN

AERONAUTICAL ENGINEERING

Specialising in
SYSTEMS or STRUCTURAL DYNAMICS

The successful candidate will be required to pursue research and undertake teaching in the area of aircraft structural dynamics, including aerelasticity and active control of structural dynamic response in collaboration with other departments and generally to contribute to the Department's teaching of the theory of Aerospace Structures. The post would most suit a candidate having a structural dynamics background with an interest in control. The age limit for applicants is 35. Persons holding permanent University appointments in the UK are ineligible for consideration. Candidates should have some experience in research.

The research-active Department has strong links with industry and the establishments and, together with sister departments, is well equipped with a powerful industry compatible CAE facility, wind tunnels, structural test facilities and data acquisition systems. A research flight simulator is planned. The Department offers enhanced and extended degree courses in Aeronautical Engineering and Avionics.

Salary will be within the range (£750-£14925 on the Lecturers' scale, with placement according to age, qualifications and experience).

Further particulars may be obtained from the Academic Personnel Office, University of Glasgow, Glasgow G12 8QQ, where applications (with CV, references, and addresses of three referees, should be lodged on or before 24 May, 1985.

In reply quote Ref No 5442N

Investigators required for roof tile enquiry

PROCESS TECHNOLOGISTS

Redland Roof Tiles are the world's leading manufacturers of concrete roof tiles and, with constant improvements in materials, products and manufacturing processes we are able to keep in front of the competition.

At the moment we are looking for 2 Process Technologists to help with continued investigation and development of our products, processes and raw materials.

An ideal job for anyone who thrives on putting the results of their lab work into practise on the production line in the UK and overseas.

You will be carrying out development work and investigations on raw materials and processes in the lab and improving present manufacturing methods. You will find the position both challenging and interesting and we will expect to see your enthusiasm and initiative in the way you follow a problem through, with accurate work and concise reports.

Previous experience in an industrial environment would be an advantage, but more important is that you have a science degree and are the kind of self-motivated person who has the enthusiasm to investigate and develop.

We'll offer you a competitive salary and an attractive benefits package.

So if you've got an enquiring mind, enquire about this excellent opportunity by writing to: David Wilcox, Personnel Manager, Redland Roof Tiles Ltd., Redland House, Reigate, Surrey RH2 0SJ. Tel: Reigate 42488.

Redland

ROOF TILES

EDITORIAL ASSISTANT

IRL Press is an expanding and innovative publishing company with a growing list of journal, book, software and video titles. As a result of our expanding publications programme, we are looking for a graduate in the biological sciences, preferably with some relevant experience, to assist in our editorial production department. The successful candidate would be involved in all aspects of the preparation for press of our publications, from subediting and proof-reading to liaison with authors and editors. We work to tight deadlines and, thus an ability to work under pressure is essential, as is an eye for detail. The position offers an ideal opportunity for anyone wishing to establish and develop a career in academic publishing. Salary dependent on experience, but in the region of £6000-£8500.

Please apply in writing enclosing a full curriculum vitae to: Anne Gent, IRL Press, Southfield Road, Eynsham, Oxford OX8 1JJ.

IRL PRESS

Oxford - Washington DC

ADAS

Agricultural Science Service

PLANT HEALTH AND SEEDS INSPECTORS

These posts in the Ministry's regional network are concerned with preventing the spread of dangerous plant pests and diseases and protecting the interests of consumers. The work, which involves direct contact with farmers, growers and seed merchants, includes inspection of plants and planting material entering or leaving the country, inspection of crops in the field and soil sampling.

You should normally have a degree (or equivalent) in Agriculture, Horticulture or related biological sciences or HND. Exceptionally you will be considered if you have a sound knowledge of agriculture or horticulture (preferably with some

formal training) and hold GCE passes in English Language and 4 other subjects, including 2 at 'A' level of which one must be in a scientific subject. A full UK driving licence is essential. Salary starting at £7190, rises to £8150. Promotion prospects.

For further details and an application form (to be returned by 19 April 1985) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 468551 (answering service operates outside office hours). Please quote ref: S/6500.

The Civil Service is an equal opportunity employer

Ministry of Agriculture, Fisheries and Food



THE ROYAL SOCIETY
FOR THE PROTECTION
OF BIRDS

Assistant Regional Officer—
East Midlands

This new post, based at the Society's Lincoln office, is to assist the Regional Officer with a wide range of work covering the whole spectrum of RSPB activities.

Duties will be dependent to some extent on the aptitude of the selected candidate but emphasis will be on liaison with RSPB Members Groups, stimulating interest in the Society through organisation of special events and assistance to Regional Officer on conservation functions.

Candidates, aged 23-35 should possess good ornithological knowledge, ability to organise and talent for public speaking. Degree is biological subject desirable. Current driving licence essential. Regular and unusual hours of work are involved.

Salary range (subject to review 1 April 1985): £16 020 pa (12 increments) allowing salary above £16 020 for a candidate with particularly relevant experience.

For further details and application form send SAE to Personnel, The Lodge, Sandy, Beds.

UNIVERSITY COLLEGE CARDIFF

Physien Department

POSTDOCTORAL RESEARCH
ASSISTANT

Applications are invited for a Research Assistant to join a research team using various methods for characterising alloys for innovative purposes. Close collaboration with industry will be established during the course of this work. Experience in ultrasonics and electronics would be an advantage. The appointment will be made for a fixed period of two years, within the salary range RA 1A £8920-£9390 ps. Duties to commence as soon as possible.

Applications (two copies), together with the names and addresses of two referees, should be forwarded to the Establishments Officer, University College, PO Box 76, Cardiff CF1 1XL. Closing date 18 April, 1985. Ref. 2923.

UNIVERSITY OF OXFORD

University Lecturership in Distributed Computing (in association with Pembroke and Somerville Colleges)

Applications are invited for a university lecturership in Distributed Computing tenable from 1 October, 1985. The appointment will be made under the University Grants Committee's scheme, in association with the Science and Engineering Research Council, for financing a number of additional Information Technology posts in universities. This post may be held in conjunction with a fellowship at Pembroke College and a lecturership at Somerville College.

Further particulars may be obtained from Professor C. A. R. Hoare, FRs, The Computing Laboratory, 8-11 Cable Road, Oxford OX1 3DD (Telephone Oxford (0865) 54141), to whom applications (ten typed copies, or one from overseas applicants), should be sent. (Separate application is not necessary for the associated college appointments.)

The closing date for receipt of applications is 22 April, 1985.

FORTH RIVER PURIFICATION BOARD

COMPUTER PROGRAMMER/ SYSTEMS ANALYST

An enthusiastic graduate in computer science or an allied subject is required to complete a small unit providing central data processing and information services to the Board.

The principal duties will include programming, assisting with systems analysis, operation of the database and associated hardware, and providing assistance/training to users.

The present system is based upon a Data General Nova 3. A new system, probably based upon a combination of a Nova and external hardware, will be implemented this year.

NJC conditions of service. Salary scale £8620-£9795 per annum.

Application forms and job description available from Administrative Officer, Colinton Dell House, West Mill Road, Edinburgh EH13 0PW. Telephone 031-441 4591. Closing date for completed applications: Thursday, 11 April, 1985.

UNIVERSITY OF DUNDEE

Cardiovascular Epidemiology Unit
Ninewells Hospital &
Medical School

SURVEY ANALYSTS (2 POSTS)

Applications are invited for two posts of Research Assistant in the Cardiovascular Epidemiology Unit (Director Professor Hugh Tunstall Pedoe). This Unit is undertaking a long term programme of epidemiological research into heart disease. The successful candidates will be involved in the analysis of data from population based surveys of cardiovascular disease and risk factors, and of data on time trends and regional variations in coronary heart disease.

Applicants should hold a degree or equivalent qualification with experience in computer programming and statistics. Appointee will be for three years and will be on the Research & Analogous Scale (IB) £6600-£8920.

Further particulars are available from the Personnel Office, The University, Dundee DD1 4HN, with whom applications giving full career details and names of two referees should be lodged by 19 April, 1985. Please quote Ref EST/62/BSH.

LIVERPOOL HEALTH AUTHORITY

Royal Liverpool Hospital, Prescott
Street, Liverpool L7 8XP

RESEARCH PHYSICIST

A good honours graduate in physics or allied subjects is required for the above post for one year. The post is the result of a grant to investigate neonatal bone mineral measurements and will be based jointly at the Royal Liverpool Hospital and Mersey Regional Radiation Service in Liverpool.

This post offers a challenging opportunity to a young graduate wishing to spend a short period of time devoted to a specifically oriented research project. A willingness to work alongside the clinical and nursing specialists is essential.

Salary in the range £6589 to £8726 depending on qualifications and experience. Further details available from Dr Harold Stockdale, Principal Physicist, Royal Liverpool Hospital (Tel 951 709 0141, Ext 2730). Applications forms and job descriptions from the Personnel Department at the above address Ext 2883. Closing date for applications is 17 April, 1985.

CRANFIELD

Industrial Postgraduate
RESEARCH ON FLUIDS

Graduate engineers in employment can undertake Total Technology PhD projects in industrial fluid mechanics without disrupting their careers. Suitable candidates qualify for SERC support and collaboration with employers ensures that there is no loss in income. Research projects, including interdisciplinary aspects such as management, production and marketing, are undertaken at work with academic and industrial supervision. Applicants should have a first or upper second class honours degree in a subject such as engineering, physics or mathematics and should have obtained the agreement, in principle, of their employer.

Further details and application forms from Dr V. Morris (Ref TT). Department of Fluid Engineering & Instrumentation, Cranfield Institute of Technology, Cranfield, Bedfordshire MK43 0AL. Tel Bedford 750111, Ext 3422.

**CSIRO
AUSTRALIA
RESEARCH SCIENTIST/
SENIOR RESEARCH SCIENTIST
\$A25 342 - \$A37 274
DIVISION OF APPLIED PHYSICS
LINDFIELD NSW**

FIELD: Acoustics

CSIRO conducts scientific and technological research in laboratories located throughout Australia and employs about 7500 staff, of whom some 2900 are professional scientists. The Organisation's research activities are grouped into five Institutes: Animal and Food Sciences, Biological Resources, Energy and Earth Resources, Industrial Technology and Physical Sciences. The CSIRO Division of Applied Physics is a member of the Institute of Physics Sciences.

GENERAL: The Division maintains Australia's primary standards of physical measurement, provides first-level calibration services in terms of those standards, and undertakes a wide range of research in applied physics related to the needs of industry and the community. The research includes programs, for example, in electrical measurement, electrical discharges, thin films, optical radiometry, magnetic properties of materials and ultrasonic non-destructive testing. The newly constructed National Acoustic Laboratories of the Commonwealth Department of Health are situated nearby.

In the field of acoustics the Division provides first-level calibration services for microphones, sound-level meters and other measuring instruments. A need is recognised to extend these capabilities to other quantities such as intensity and power. The two scientists at present responsible for the acoustics standard program will retire during 1985.

DUTIES: To undertake research required for the establishment of standards of measurement and calibration services in acoustics. The appointee will be encouraged to pursue applied research in other areas of acoustics as well, and to establish strong contacts with scientists in related fields and with industry.

QUALIFICATIONS: A PhD or equivalent qualification in physics or engineering, preferably with a background of research experience and achievement in the field of acoustics.

TENURE: Indefinite with Australian Government superannuation benefits available.

APPLICATIONS: Stating relevant personal particulars, including details of qualifications and experience, the names of at least two professional referees and quoting reference No A4249, should be directed to:

The Chief
CSIRO Division of Applied Physics
PO Box 219
LINDFIELD NSW 2070
AUSTRALIA

by 19 April, 1985

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M. H. Randall & Partners Limited, one of Europe's leading technical translation organisations, require the following staff:

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B) Graduates in one of the Natural Sciences (Chemistry, Biochemistry, Physics, Biology) or in Medicine and/or Pharmacology. Applicants must be completely conversant with German and/or French. Additional languages, notably Italian and/or Spanish, could be useful. Previous experience in professional translation work will be an advantage but is not a pre-requisite.

The positions offer scope for substantial five figure earnings linked directly to performance, + free BUPA.

Please write with full CV to:

Dr W. G. Barb, M. H. Randall & Partners Limited, Europa House, Marsham Way, Gerrards Cross, Bucks SL9 8BQ.

Clinical Research Executive?

Join a world leader
in pharmaceuticals...

... and develop your skills by working as part of a small clinical research team, each of whom is responsible for their own projects. You will be designing, monitoring and reporting clinical trials - initially working on antibiotics in Phases I to III - within the medical department at our impressive new headquarters in Denham, Bucks.

You must have a first degree in a biological science and 3-4 years' experience in clinical trials in the pharmaceutical industry, ideally in the field of antibiotics. You will certainly need to possess plenty of self motivation and a flexible approach to your work, and be able to communicate easily both verbally and in writing.

We provide structured career development and, as part of the world's largest and most innovative ethical pharmaceutical company, we also provide an excellent salary. A first-class range of benefits includes free family BUPA after a year's service, free restaurant, free life and personal accident insurance, contributory pension, and relocation assistance where appropriate.

Please send a detailed cv, including current salary, or ring or write for an application form to:
Mrs Elizabeth Bedford, Roussel Laboratories Limited, Broadwater Park, North Orbital Road, Uxbridge, Middlesex UB9 5HP. Telephone: 0895 834343.



WEST LAMBETH HEALTH AUTHORITY
St Thomas' Hospital, London SE1 7EH

BIOENGINEER/ MEDICAL PHYSICIST

A Bioengineer/Medical Physicist is required for the Neonatal Intensive Care Unit at St Thomas' Hospital. Duties will include the development of new equipment, techniques and software and some maintenance of essential equipment both within the Unit and on the Labour Ward.

The post would suit a Graduate with 1st or 2nd Class Honours in Electronics engineering of Physics and the appointee would be responsible jointly to the Director of the Neonatal Unit and the Head of the Department of Bioengineering.

Research opportunities for suitable appointees would be considered.

Salary Scale: £7463-£9405 inclusive of London Weighting.

Application form and job description available from Personnel Department, St Thomas' Hospital. Telephone 01-928 9292 Ext 2422.

Closing date for completed applications: 12 April, 1985.

National Museum of Photography, Film and Television - Bradford

CURATOR OF THE KODAK MUSEUM

The National Museum, a unique partnership between the Science Museum, London and the Bradford Metropolitan Council, which will eventually have 20,000 sq ft of exhibition area, attracts many thousands of visitors from this country and overseas.

The successful candidate will be responsible for the soon-to-be-acquired Kodak Museum, currently located in Harrow, which traces the development of photography with the evolution of the camera as its central theme and includes 10,000 photographs. Work will include organising completion of the transfer to the National Museum in Bradford, liaising with Museum staff over its public display and promotion, and reviewing documentation, cataloguing, conservation and restoration needs.

Candidates (normally at least aged 26) must have considerable relevant museum experience or a sound knowledge of the development of photography, its processes and technology. They should preferably have a good degree or an equivalent qualification in a relevant subject.

Salary, as Curator Grade D, £8645-£13140. Starting salary according to qualifications and experience.

For further details and an application form (to be returned by 22 April 1985) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 466551 (answering service operates outside office hours).

Please quote ref: G(10)362.

An equal opportunity employer

ASSISTANT SCIENTIFIC OFFICER

There is a vacancy for a Assistant Scientific Officer in the Fish Section of the Animal Products and Feeds Department of the Tropical Development and Research Institute at Gray's Inn Road, London. The post is permanent and pensionable.

The Fish Section is involved in all aspects of post harvest handling, processing and preservation of fish and fish by-products in the developing world. The work will be varied but will include involvement in biochemical analyses, product development, pilot scale production trials, assistance in organising the laboratory and answering enquiries received by letter or from visitors.

Qualifications: Passes in at least 4 subjects in GCE, GSE grade 1 or equivalent. The passes must include English Language or Literature, a science or mathematical subject and not more than one subject of a mainly artistic or domestic kind.

Salary in the range £4059-7615 according to age and experience.

Hours: 41 hours per week (five day) including lunch breaks.

Leave: 22 working days per annum plus public and privilege holidays.

The Tropical Development and Research Institute is a scientific unit of the Overseas Development Administration. The main emphasis of the work of this British Government Research Institute is on the improvement of food supplies, in accordance with one of the major objectives of the British Overseas Aid Programme.

To apply, write for an application form to Mr H. Woodman (ASCP/BS), TDR, 127 Chesham Road, London EC1R 5DB. Closing date for receipt of enquiries is 1 April, 1985.

THE CIVIL SERVICE IS AN EQUAL OPPORTUNITIES EMPLOYER

Statistician

A vacancy has arisen for a statistician at our R & D Laboratories Loughborough. The Statistics Department provides a mathematical and statistical service to our Research and Development Laboratories from basic research through to clinical trials.

The work will be centred around clinical trials and will involve advising on the design of trials, the analysis and interpretation of data and clear and concise report writing. There will also be scope for work outside the clinical area. Computer facilities are available on our VAC 11/780.

The successful candidate will have a degree in an appropriate subject or be a Member of the Institute of Statisticians. Ideally we would like someone with relevant experience but are willing to consider new graduates/MSc candidates. The appointed person will be required to work with the minimum of supervision, demonstrate initiative and be able to communicate effectively with scientific staff. Both GLIM and BMDP are available and experience with either of these statistical packages would be useful.

The benefits of working for Fisons include an attractive salary, profit sharing bonus, flexible working hours, an active Sports and Social Club and generous relocation expenses where appropriate.

If you wish to apply please write for an application form quoting reference number 980/NS to Mrs Oliva Jones, Personnel Officer, Fisons plc - Pharmaceutical Division, R & D Laboratories, Bakewell Road, Loughborough, Leicestershire LE11 0RH.

FISONS
Pharmaceuticals

DEPARTMENT OF ANTHROPOLOGY, UNIVERSITY COLLEGE LONDON AND DEPARTMENT OF HUMAN NUTRITION, LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE

JOINT 'NEW BLOOD' LECTURESHIP IN NUTRITIONAL ANTHROPOLOGY

Owing to the creation of a joint 'New Blood' lectureship, applications are invited from candidates with interests in the interdisciplinary and comparative study of nutritional problems in both the underdeveloped and developed worlds. Persons with training in the social aspects of either anthropology or nutrition are encouraged to apply, although a basic knowledge of the physiology of human nutrition is likely to be an advantage. If required, the successful applicant may be asked to undergo additional research training in nutrition or anthropology in the early years of the appointment. Candidates should be aged 35 or under, and persons holding permanent university posts in the UK are ineligible. Salary will be on scale £7620-£14 925 + £1233 L.A. Applications (in forms) including a cv and names and addresses of two academic referees should be submitted to: Assistant Secretary (Personnel), University College London, Gower Street, London WC1E 6BT. Closing date: 30 April, 1985.

THE LONDON HOSPITAL MEDICAL COLLEGE (University of London)

'NEW BLOOD' LECTURESHIP: MEDICAL MICROBIOLOGY

Applications are invited for a Lectureship in the Department of Medical Microbiology, from candidates with research experience in the field of molecular biology, to work on cloning of lymphokines and new recombinant vaccines. Candidates should normally be less than 35 years of age, but exceptionally well qualified candidates just over this limit may be considered.

Salary within the appropriate University of London range (£8753-£18 158 Non-Clinical or £10 937-£18 367 Clinical inclusive of London Weighting).

Further information and applications (including curriculum vitae and the name of two referees) should be sent to Dr A. R. M. Coates, Department of Medical Microbiology, The London Hospital Medical College, Turner Street, London E1 2AD. Tel 01-977-8800, Ext 102 or 105.

WELLCOME IMMUNOTOXICOLOGY UNIT, DEPARTMENT OF PHARMACOLOGY, OXFORD POSTGRADUATE RESEARCH ASSISTANT

A postgraduate research assistant is required to work on the mechanisms of toxic side effects of drugs. The toxic effects induce production of autoantibodies. The techniques involved will be tissue culture, protein purification and development of monoclonal antibodies. The post is for three years from 1 October, 1985 and is funded by the Arthritis and Rheumatism Council. Salary scale £6310-£7190. The successful candidate may be eligible to register for a higher degree. Applicants, who should have, or expect to have, at least a 2:1 degree, can obtain further details from Dr E. Sim, University Department of Pharmacology, South Parks Road, Oxford OX1 13QT. Applications, with the names of two referees, should be sent by 30 April, 1985.

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in a science subject?**

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Mars Confectionery is an established leader in one of Britain's most competitive consumer markets — confectionery. Nothing is more vital to maintaining our enviable position than an innovative programme of R&D. And this in turn calls for the highest-calibre graduates — creative individuals who can set new standards within our high-technology R&D environment, who also possess the potential to become the managers of tomorrow.

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of around £18,000 of today's rates. And that appointment need not be restricted to R&D.

Starting remuneration will be not less than £8,750 with 6-monthly merit awards to follow. A generous range of non-contributory benefits (including relocation assistance if necessary) completes the package.

If you're graduating this year and rapid career progress is your goal, call Eoin Kavanagh, Graduate Recruitment Officer, on Slough (0753) 23932 for an application form. Or write to him, outlining your suitability for one of these opportunities, at Mars Confectionery, Dundee Road, Slough, Berkshire SL1 4JX.

Mars

COMPUTER SCIENTIST

Cancer Research Campaign Project

Applications are invited from experienced computer scientists to undertake an 18-month project continuing the support and development of COMPACT, a package for handling data for multicentre clinical trials. The package covers all stages of trials from data collection up to analysis. On of the duties will be to implement the system on a wide range of mini-computers with possible extension to micro-computers.

The applicant should have a good honours degree in computer science or equivalent experience but would not necessarily have a medical background. The project will be based at the address below, but will be supervised by a steering committee from several major cancer institutions. The salary will be at an appropriate point on university lecturer scales and will be up to £14 925 + London weighting.

Applications with a detailed curriculum vitae and names of two referees should be sent to: The Director, MRC Tuberculosis and Chest Diseases Unit, Brompton Hospital, Fulham Road, London SW3 6HP.

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For further information and an application form please contact John Spencer or send a detailed C.V. Please quote reference NS/G



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**LOUGHBOROUGH
UNIVERSITY
OF TECHNOLOGY**

CHAIR IN HUMAN BIOLOGICAL SCIENCES

Applications are invited for the Chair in Human Biological Sciences in the Department of Human Sciences. Human biology and environmental biology are now studied together as Human Biological Sciences within the Department. Candidates should have a proven record in an appropriate area, for example, human growth and nutrition, or biomedical or physiological measurement. Candidates should also be interested in fostering developments in pollution studies, environmental health and biological resource management. The appointee will provide leadership and support for all staff engaged in this multidisciplinary study of Man and his biological environment.

Further particulars and application forms can be obtained from the Registrar. Salary will be within the professional range (current maximum £18 070 and subject to review from 1 April). Informal enquiries may be made to the Head of the Department, Professor N. S. Kord.

Loughborough

Leicestershire

UNIVERSITY OF BATH School of Materials Science LECTURESHIP IN MATERIALS SCIENCE

The person appointed will be expected to share the teaching of Materials Science and Technology to students of Materials Science and of Engineering, and to participate in the development of new research programs and industrial links.

A suitable candidate would be likely to have a PhD or equivalent qualification, and a background in the field of glass and/or ceramics technology, preferably with some experience of industrial research or development in that field.

Salary within the range £7550-£14 925.

Further particulars and application forms may be obtained from the Personnel Officer, University of Bath, Bath BA2 7AY quoting reference number 65/45.

Closing date: 22 April, 1985.

THAMES POLYTECHNIC School of Biological Sciences and Environmental Health ANIMAL TECHNICIAN (GRADE 4)

Applications are invited from suitably qualified and experienced persons for a post of animal technician to carry out a range of duties in an animal house where small mammals, insects and chickens are kept. Some weekend work is involved but these duties are shared with other technician staff. The post would be suitable for someone currently studying for the Associateship examination of the Institute of Animal Technicians.

Salary scale: £6808-£7726 inclusive.

Further particulars and application form from Staffing Officer, Thames Polytechnic, Wellington Street, London SE18 6PP, to be returned by 16 April, 1985.

Thames Polytechnic is an equal opportunities employer.

UNIVERSITY OF LONDON GOLDSMITHS COLLEGE School of Science and Mathematics LECTURER IN BOTANY (1 year temporary appointment 1985-1986)

Applications are invited for a one year temporary lectureship in botany. The appointee will be expected to participate in teaching first year undergraduate courses in morphology and taxonomy and some higher level courses, preferably in the area of cell biology.

The salary will be on the scale £8586 x 12 increments to £14 166 pa, inclusive of London Allowance.

Write for further details to the Senior Assistant Registrar (Personnel), University of London Goldsmiths College, New Cross, London SE14 6NW by 3 April, 1985.

BROMPTON HOSPITAL Junior Technician/ Technician Lung Function Unit

The person appointed will be expected to conduct a wide range of respiratory tests in this busy unit on patients with pulmonary and cardiac diseases.

Salary according to age, qualifications and experience within range £4717-£8168 inclusive of London Weighting (Pay rise pending).

Further information from Mr D. Cramer, Chief Technician, Tel: 01-352 8121 Ext 4423.

Application form and job description from Mrs J. Wahan, Assistant Personnel Manager, Brompton Hospital, Fulham Road, London SW3 6RP. Tel see above Ext 4458 (24 hour answering service). Closing date: 12 April, 1985.

Graduate Microbiologist South Coast

Beecham Pharmaceuticals at Worthing employs about 1,850 people in production, research, engineering and associated service functions.

A vacancy has now arisen for a Graduate Microbiologist to join our Pharmaceutical Production Quality Assurance Laboratory.

Applicants should combine an innovative approach with the ability to motivate experienced technicians. They will enjoy the prospect of working as part of a team involved in ensuring compliance with good pharmaceutical manufacturing practice in the production of sterile end non-sterile preparations. It is likely that some method development will also be involved.

The successful candidate will probably have additional experience in the pharmaceutical or food industry, and some knowledge of computer programming would be a further advantage.

The Beecham Group offers an attractive starting salary backed by excellent conditions of service including a non-contributory pension and life assurance scheme. Worthing is situated in a pleasant coastal area with many amenities and easy access to the surrounding countryside. Assistance with relocation expenses will be given if appropriate.

Please write or telephone to: Mr R P Reynolds, Senior Personnel Officer, Employee Relations Department, Beecham Pharmaceuticals, Clarendon Road, Worthing, Sussex BN14 8CH. Tel: Worthing (0903) 39900, ext 332.

Beecham Pharmaceuticals

THE UNIVERSITY OF SHEFFIELD Department of Electronic and Electrical Engineering CODUS Databank

Applications are invited for two posts, one of

RESEARCH ASSISTANT

the other of

INFORMATION OFFICER/TECHNICAL WRITER

to join the CODUS Databank team in the above Department. Both posts will be tenable for one year in the first instance.

CODUS is a computer based databank holding information on over 65,000 electronic components approved under the quality assurance procedures of BS9000 and ISO9000. The databank is being used increasingly by manufacturers of electronic equipment in the UK, and overseas is currently under way to make the facilities available throughout Europe.

The person appointed to the Research Assistant post will be required to take charge of those aspects of the databank concerned with future-use models and reliability prediction. Applicants should possess a good degree in electronic engineering or a related subject. The ability to write computer programs in FORTRAN is essential and experience or qualifications in one or more of the following areas would be desirable: electronic component technology, statistical methods, quality assurance or reliability engineering.

The Information Officer/Technical Writer will be required to take charge of the documentation produced for databank users and of all related system documentation and to answer technical queries on the databank and its operation. Applicants should be graduates who have followed a course with a significant element of computing and with, preferably, some electronics. The ability to write clearly about technical matters is essential.

Applications, with full curriculum vitae and the names of three referees, should be sent, to arrive not later than Wednesday, 10 April, to:

Dr R. Taylor
CODUS Databank
Department of Electronic & Electrical Engineering
The University of Sheffield
Maple Street, Sheffield S1 5JD.

From whom further details of the posts and the CODUS databank are available.

Salaries, which will be determined according to age, qualifications and experience, will be on scales 1A or 1B for Other Related Staff. Quoted Ref 239/H.

KING'S COLLEGE LONDON Department of Anatomy & Human Biology TECHNICIAN GRADE 4-2 YEAR APPOINTMENT

To be in charge of the day-to-day running of practical classes for medical, dental and BSC students in the Department. There are Faculty laboratories serviced by a departmental preparation room, ONC or equivalent qualification required, with a minimum of seven years' experience, which should include histology. The successful applicant will be responsible for the expansion of histology teaching material. Salary on scale rising from £7356 per-£8274 pa (inclusive), 37 hour week Monday-Friday, five weeks annual holiday, plus six additional days when the College is closed at Easter and Christmas. Contributory Superannuation Scheme. Season ticket loan.

Apply in writing, with full details, to: Mrs A. Phillips (ref. 237006) King's College, London, Strand, London WC2R 2LS.

UNIVERSITY OF EXETER Department of Engineering Science LECTURER IN ENGINEERING SCIENCE

The department which is of the unified-engineering type provides courses for both three & four year engineering degrees. A lecturer is sought having a major interest in Information Technology and its applications to pursue developments in these topics in teaching and research.

Salary will be within the range £7520-£10 720 pa on the scale £7520-£14 925 pa.

Further particulars available from: The Personnel Office, University of Exeter, Exeter EX4 4JL to whom applications (six copies, overseas candidates one copy) giving the names of three referees should be sent by 19 April, 1985, quoting reference number 3413.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (University of London)

Department of Medical Protozoology MEDICAL LABORATORY SCIENTIFIC OFFICER

A well-qualified technician (BSC, HTEC or equivalent), is required for one year, to study the infectivity and cross immunity of Leishmania.

Previous laboratory experience, including knowledge of culture and aseptic techniques, and the ability to work with laboratory animals would be advantageous. Work to be based in St Albans.

Salary scale £6780 to £7768 pa. Please write with full cv to the Assistant Personnel Officer, Keppel Street, London WC1E 7HT. Closing date 10 April, 1985.

FRENCH HEALTH AUTHORITY

Borden Neurological Hospital,
Stoke Lane, Stapleford, Bristol

Physiological Measurement Technician (Basic Grade)

Applications are invited from qualified experienced technicians for this position. All aspects of neurophysiological measurement are undertaken in this unit including hospital, ambulatory monitoring, ICU, SCG, Taper, EMG, and multi-channel EMI recording.

This vacancy arises due to expansion of services. Further enquiries to Mr A. Water, Tel: (0273) 34346 Ext 414.

Please write for an application form (enclosing postage stamp) to the Personnel Officer, Frenchay Hospital, Bristol BS16 1UH. Closing date for completed applications 9 April, 1985.

We are an Equal Opportunities Employer.

UNIVERSITY OF BIRMINGHAM FACULTY OF SCIENCE AND ENGINEERING RESEARCH POSTS

Applications are invited for the following research posts in Departments in the Faculty of Science and Engineering:

DEPARTMENT OF MICROBIOLOGY

Postdoctoral Research Fellowship (M1)

To work on the epidemiology of potexviruses and aspects of resistance. Experience in plant virology or nucleic acid biochemistry would be an advantage. Post tenable for up to 17 months and funded by AFRC.

DEPARTMENT OF BIOCHEMISTRY

ENZYME KINETICS AND SPECTROSCOPY LABORATORY

Research Fellowship (B3)

To work on an SERC funded project with Dr C. W. Wharton (Birmingham) and Professor R. E. Hester (Department of Chemistry, York). Kinetics and ultra-violet resonance Raman spectroscopy of transient intermediates in papain- and GAPDH-catalysed reactions. Project will be at Birmingham, York and SERC Rutherford-Appleton Laboratory, Harwell. Tenable for up to two years. Starting salary probably just above £7980.

DEPARTMENT OF CHEMICAL ENGINEERING

Research Associateship/Fellowship (T1)

To work on a joint project in the field of fluid flow and heat transfer with AERE Harwell. Chemical or Mechanical Engineers preferred, but consideration would be given to other suitably qualified persons.

DEPARTMENT OF CHEMICAL ENGINEERING

Research Associateship (T5)

To work with a Teaching Company involving co-operation with Courtauld plc, Coventry in the development of plastic tube heat exchangers for use in distillations and other process involving laboratory and full scale trials. Tenable for up to two years.

DEPARTMENT OF CHEMICAL ENGINEERING

Postdoctoral Research Fellowship (T6)

To work on the preparation, characterisation and development of intermetallic hydrogen diffusion membranes as catalysts for hydrogenation reactions in the gas and liquid phase. Tenable for up to three years.

SALARY SCALES

Research Associate 1B £6600-£8920 plus superannuation

Research Fellow 1A £7520-£12 150 plus superannuation

For further particulars, Tel 021-472 1301 Ext 2559 quoting reference numbers above.

No formal application form. Three copies of application, including full cv and naming three referees to Assistant Registrar (Science and Engineering) PO Box 363, Birmingham B15 2TT by 11 April, 1985.

ROYAL HOLLOWAY AND BEDFORD COLLEGES Egham Hill, Egham, Surrey TW20 0EX

Technicians

TRAINEE TECHNICIAN

required for technical duties in the research areas of the Chemistry Department. Must have four 'O' levels or Grade 1 CSEs, two of which must be in a Science subject. Day release given.

GRADE 5 ELECTRONICS TECHNICIAN

required in the Computer Centre to assist with the installation of new connections to the College X25 local area network and with the operational maintenance of this system. The technician is also required to construct microprocessor boards to provided specifications to maintain certain items of equipment and to maintain stocks of chips, boards and other components. The provision of advice to customer departments is an important element of the work. The technician should have GNC standard electronics or any similar training or experience and will undergo further in-house training.

GRADE 5 MECHANICAL WORKSHOP TECHNICIAN

required for the Chemistry Department to work with one other on the development, construction, modification and repair of scientific equipment and apparatus using a wide range of materials and workshop techniques.

Experience of precision turning, milling and fitting essential.

SALARY SCALES

TRAINEE £2673-£4962 including London Allowance.

GRADE 5 £7081-£8184 including London Allowance.

Please apply in writing giving details of age, qualifications and experience, together with the names and addresses of two referees to: Mrs D. J. Odds, Personnel Officer.

UNIVERSITY OF CAMBRIDGE Department of Engineering

University Lecturers/ Assistant Lecturers

Applications are invited for University Lecturers or University Assistant Lecturers. The Appointments Committee hope to be in a position to make appointments in each of the following fields.

Micro-electronics—High speed electronics

To undertake research in electron beam methods for the fabrication and high-speed testing of sub-micron and integrated circuit devices. Work will include the design of electron probes and detectors for lithography and testing. Computer image processing will be used for analysis of test and alignment images. The person appointed will be expected to teach digital and analogue circuits and devices in all the years of the undergraduate course.

Micro-electronics—VLSI Process Technology

To work with electronic materials for advanced integrated devices undertaking research in processes for fabricating sub-micron CMOS and bipolar integrated circuit components, including chemical vapour deposition, reactive ion etching, ion beam etching, and optical and electron beam lithography. The person appointed will be expected to teach electronic materials and device fabrication in all the years of the undergraduate course. This vacancy has been created by the Information Technology scheme.

Materials

To strengthen research in the group working on the mechanics of plasticity, creep and fracture. The person appointed would be expected, in due course, to participate fully in the teaching of Engineering Materials in all the years of the engineering course, with particular emphasis on production, processing and the role of Materials in design. This vacancy has been created under the New Blood scheme.

Mechanics

To join a group working in the field of applied mechanics. Preference will be given to candidates whose interests lie in the field of dynamics, particularly where related to the aerospace industry. The person appointed would be expected to participate fully in the teaching of mechanics in all the years of the undergraduate course.

Design and manufacturing

To join a group in production engineering. The person appointed will be required to assist in the organisation and co-ordination of project activities in industry and to teach in all the years of the undergraduate course, including the Production Engineering Tripos. Preference will be given to candidates with a background in the field of design for manufacture but others with similar relevant experience are invited to apply.

Persons holding a permanent appointment in a UK university are not eligible for appointment to vacancies created by the UGC Information Technology or New Blood schemes; additionally persons over 35 years of age are not eligible for the New Blood appointment.

Those appointed will be expected to play their part in the general teaching of the Department and this may mean teaching outside their precise area of specialisation.

The appointments will be made at either University Lecturer or University Assistant Lecturer level depending on the age and experience of the persons concerned. The pensionable scales of stipends, for persons not ordinarily resident in College, are:

University Lecturer £10 330 per year rising by eleven annual increments to £15 930.

University Assistant Lecturer £7980 per year rising by four annual increments to £9840.

The New Blood and Information Technology appointments will be from 1 October 1985, or as soon as possible thereafter; the other appointments may be made from an earlier date.

Further information and application forms may be obtained from the Secretary of the Appointments Committee for the Faculty of Engineering, Department of Engineering, Cambridge University, Cambridge CB2 1PZ, to whom completed application forms should be sent to reach him by 1 May 1985. In any enquiry or correspondence it should be made clear to which vacancy it applies.

THE UNIVERSITY OF LANCASTER

Department of Physics

"NEW BLOOD" LECTURESHIP IN EXPERIMENTAL LOW TEMPERATURE PHYSICS

Applications are invited for a lectureship under the "New Blood" scheme in experimental low temperature physics. Low temperature physics is one of the principal research areas of the department and excellent facilities are available. The applicant should have research interests in one or more of the following topics: quantum fluids, phonon physics, superconductivity, low dimensional properties of materials, low dimensional structures. The appointment, from 1 October 1985, will be made on the lecturer scale (£7520-£14 925 under review). Candidates should be aged 35 or under and must not currently hold a permanent university appointment in the United Kingdom. For further particulars and application form, please write to the Establishment Office (Engineering) (L174/B), University House, Bailrigg, Lancaster LA1 4YW where applications (as copies) naming three referees should be sent to arrive NOT LATER THAN 30 April 1985.

Immunologist

Nottingham Based

The Boots Company has a forward looking research group engaged in the discovery and development of drugs which modify immune responses.

Expansion of our involvement in this research has created a vacancy for a post doctoral scientist who has an interest in the mechanisms of autoimmune diseases in experimental models.

Applicants should be in their mid to late twenties and have a broadly based PhD in the immunology and/or pathology of autoimmune disease.

The post offers an excellent opportunity for a scientist to develop ideas and to demonstrate initiative in this exciting area of the Company's research programme.

Benefits are those to be expected of a large Company and include profit sharing bonus and staff discount privileges. Generous help with relocation to the Nottingham area is available if applicable.

Write or telephone for a personal data form to: Mr. T. W. Flower, Employment Manager (Technical) The Boots Company PLC, Station Street, Nottingham NG2 3AA. Telephone: Nottingham (0602) 506255 Ext. 243.

The Boots Company PLC



University of Reading

Lectureship in Modern Optics

Applications are invited for a lectureship vacating from 1 October 1985 within the Optics Group of the Physics Department. Candidates should have an active research interest in some aspect of applied modern optics, relating to either optoelectronics or laser studies. A preference exists for the first mentioned subject area. Salary on the scale £7520 to £14925 (as plus USS/RSRS benefits). Further particulars and application forms (two copies) are available from the Personnel Officer, University of Reading, Whiteknights, PO Box 217, Reading RG6 2AA. Tel: (0734) 873123 ext 220. Please quote Ref. AC 851. Closing date 30 April 1985.

UNIVERSITY COLLEGE CARDIFF

Archaeology Department RESEARCH ASSISTANT

Applications are invited for a Research Assistant Grade 1B, to work on the Malpas from the Historic Buildings and Monuments Commission's excavations at Maiden Castle. The post is for 21 years. A good first degree and/or higher degree in archaeology, zoology or other relevant subject is required. Experience of malpasian analysis is preferable but not essential. Salary range grade 1B £6600-£8920 pa. Duties to commence 1 July 1985.

Applications, two copies, together with the names and addresses of two referees, should be forwarded to the Establishment Officer, University College, PO Box 78, Cardiff CF1 1XL, from whom further particulars will be available. Closing date 3 May, 1985. Ref: 2924.

VICK INTERNATIONAL

EUROPE - AFRICA



RESEARCH & DEVELOPMENT LABORATORIES

HEMAM PARK WHITEHALL LANE, EGHAM, SURREY, TW20 8HW, ENGLAND

INFORMATION RESOURCES Graduate

We are the Research and Development Laboratories for the Europe-Africa Division of a large international Pharmaceutical Company and we wish to recruit a Graduate to work in our Information/Administration Department.

The successful applicant will assist the Information Resources Manager in providing computer services to the laboratories covering product stability control, development of an in-house database, use of commercial online retrieval services, accounts and word processing and online in other site services functions.

Preference will be given to Graduates in computer science with some experience in systems analysis. Science graduates with relevant computing experience will also be considered.

We offer an attractive salary with excellent working conditions in modern laboratories.

In the first instance please write enclosing curriculum vitae to Mrs Jeni Money at the above address, or alternatively telephone her on Egham 34422 for an application form or further information.

UNIVERSITY OF SOUTHAMPTON

Chemical Pathology and Human Metabolism

RESEARCH ASSISTANT

Applications are invited for the above post which is to run initially for eighteen months to work with Dr H. T. Delves on the use of plasma-source mass spectrometry to measure total concentrations and isotopic ratios of lead and other trace elements in biological and environmental samples. Applicants should have a good degree in Chemistry or Part II GCE and have experience of and interest in analytical science.

Salary will be on the 1B scale for research assistants. Further information may be obtained from Dr H. T. Delves (Southampton 0703-777222, Ext 3846). Applications to include full cv and the names, addresses and telephone numbers of two referees should be sent to Mr A. J. Bernal, Staffing Department, The University, Southampton SO9 5NH. Closing date: 4 April 1985. Please quote Ref no A26 55/20/NS.

University of Manchester/UMIST

Department of Metallurgy and Materials Science

LECTURER

Applications are invited for the post of Lecturer in Materials Science. Preference will be given to candidates with an interest in structure-property relationships in ceramics, but candidates with interests in the general area of structure-property relationships in materials will also be considered.

Commencing salary will be within the scale £7520-£14925 per annum. Requests for application forms and further particulars quoting reference, MET/38, should be sent to the Establishment Section, Registrar's Department, UMIST, PO Box 88, Manchester M60 1QD. The closing date is 30 April, 1985.

LUDWIG INSTITUTE FOR CANCER RESEARCH (LONDON BRANCH)

The Haddow Laboratories, Clifton Avenue, Sutton, Surrey, SM2 6PX.

THREE YEAR APPOINTMENT

A Research Assistant is sought to join a group investigating the expression of keratin and growth factor genes in human tissues. The appointee will work with a molecular biologist to develop the technique of *in situ* hybridization. Some experience with molecular techniques, tissue culture and/or histology is desirable. Salary will be in the range of £5483-£8492 pa plus £833 pa London Weighting, depending upon qualifications and experience. Applications should be sent in writing, enclosing cv and details of two referees, to the Administrator, at the above address not later than 8 April, 1985.

UNITED MEDICAL AND DENTAL SCHOOLS

Guy's Campus

RESEARCH ASSISTANT

required until 31 July, 1986, for research project on viruses in Multiple Sclerosis. Some experience of cell culture methods is essential. Salary in accordance with age, experience and qualifications. Applications, giving details of experience and qualifications and names of two referees, to the Staffing Officer, Guy's Hospital Medical School, London SE1 9RT, quoting Ref: G/M/43.



UNIVERSITY OF LONDON COMPUTER CENTRE

The University of London Computer Centre provides batch and keyboard services to over 5000 users in universities and research establishments throughout the United Kingdom. It is equipped with an Amdahl 470V/8 (IBM-compatible) and a Cray-1S supercomputer. Widespread access to the facilities at the Centre is provided by means of packet-switched networks.

Applications are invited for the following posts:

USER SUPPORT DEPARTMENT

The User Support Department is the main interface between users and the computing service. It provides advisory, documentation and user education services. The Department also supports a wide range of compilers, graphics and applications packages and libraries.

Programmer Analyst

(Technical Writing & Graphics) (US 84/6)

A Programmer/Analyst is required to work with both the team providing the technical information services and the team supporting the graphics services. The work involves both technical writing connected with all user services provided by this Department and the implementation and support of graphics software. Graduates or postgraduates with the relevant experience will be preferred.

Programmer Analyst

(Advisory) (US 85/2)

An experienced Programmer/Analyst is required to join the team currently engaged in the provision of the Advisory service. Applicants should preferably be graduates or postgraduates with a keen interest in the provision of user services and have the ability to communicate clearly.

Salaries for both posts will be commensurate with age, relevant qualifications and experience on scales £6600 to £12 150 plus £1233 London Allowance.

NETWORKS & COMMUNICATIONS DEPARTMENT

Section Leader

Communications Systems Development
(NC 85/1)

The Networks and Communications Department is responsible for communications development. There is a vacancy to lead a section of the Department which is concerned with the implementation of front-end facilities, including X25 packet-switching, protocol conversion and network interfaces to the Amdahl. Planning is shortly to begin on enhancements based on high bandwidth local and wide-area network technologies.

Remote batch and terminal access to the facilities of the Centre is being provided in conformity with the principles of Open Systems Interconnection via implementations of the academic community's standard Coloured Book protocols.

Applications are invited from candidates with proven experience in modern data communications techniques (hardware and software) and project management capabilities. Relevant academic qualifications to degree level are required.

This is a Grade 6 post in the Academic and Related Scales in salary will be commensurate with age, qualifications and experience in the range £14 135 to £17 705 plus £1233 London Allowance.

Applications for the above three posts will close three weeks after publication of this advertisement.

Further details and application forms are available from the Deputy Secretary, ULCC, 20 Gifford Street, London WC1N 1DZ. Telephone 01-405 8400.

UNIVERSITY OF GLASGOW Department of Psychology

'NEW BLOOD' LECTURESHIP

Applications are invited for a 'New Blood' Lectureship in Psychology, in the general field of cognitive science. Applicants should be qualified in psychology, and have a special interest in and knowledge of cognitive science. It is expected that the successful candidate will undertake research into knowledge acquisition and organisation, and the nature of expert understanding in some field such as physics, mathematics, computing, or logic. Experience in this branch of cognitive science is desirable, but not essential. Some knowledge of A.I. programming is desirable. Some teaching in existing cognitive science courses and a course on cognitive science and education will be required, but the main emphasis will be on research, for which ample facilities exist, including a well-equipped cognition laboratory and a VAX 11/730 running UNIX for computational modelling.

The age limit for applicants is 35. Persons holding permanent university appointments in the U.K. are ineligible for consideration.

Salary will be within the range £7500-£14 825 on the Lecturers' scale with placement according to age, qualifications and experience.

Further particulars may be obtained from the Academic Personnel Office, University of Glasgow, Glasgow G12 8QQ, where applications (8 copies), giving the names and addresses of three referees, should be lodged on or before 15 May, 1985.

In reply please quote Ref. No. 5445N.



Hydraulics Research
Wallingford

GRADUATE ENGINEERS TIDAL ENGINEERING

Post 1: Modelling Estuary Pollution

A Graduate Civil Engineer is required to assist in the development and application of computer models to predict the effect of engineering works on water quality in estuaries in the UK and overseas. The position involves working within a group of engineers and applied mathematicians, carrying out research and project studies.

Applicants should have an interest in civil engineering hydraulics and environmental studies, and possess the mathematical skills necessary for computer modelling. Prospective 1985 graduates will be considered. Salary range £6800 - £8800.

Post 2: Dredging and Sedimentation in Estuaries

A Graduate Civil Engineer with about three years practical experience is required to carry out research and project studies concerned with the physics of sediment transport and dredging in estuaries.

Applicants should have a good degree in Civil Engineering and some experience in dredging, soil mechanics or sediment physics. A good working knowledge of mathematics and some computer experience is essential. Salary range £7600 - £10 600.

The company offers excellent benefits including a non-contributory pension scheme and flexible working hours. Please write with full CV to Karen Breakey, Personnel Manager, Hydraulics Research Limited, Wallingford, Oxon OX10 8BA, or telephone Personnel on Wallingford (0491) 35381 for an application form.

UNIVERSITY OF SURREY Department of Physics

'NEW BLOOD' LECTURER IN THEORETICAL NUCLEAR

PHYSICS

Applications are invited for a 'New Blood' post from theorists with a PhD and thorough training and experience in modern nuclear theory techniques, including computation. An active interest in the Department's current areas of research in low and intermediate energy nuclear reaction theory and at the borders of nuclear, atomic, molecular and particle physics will be an advantage, but considerable weight will be placed on evidence of a clear potential for contributions to future developments in a rapidly changing field. An interest in the development of the teaching of theoretical physics at undergraduate and postgraduate level is essential.

The post is tenable from 1 August, 1985 and applicants should normally be under the age of 35 years. The post is not open to persons holding a permanent university appointment in the United Kingdom, of whatever kind. The salary will be within the Lecturer scale, £7300-£14 825 ps, according to age, qualifications and experience.

Further particulars are available from the Academic Registrar (AA), University of Surrey, Guildford, Surrey GU2 5XH, or Tel Guildford (0483) 871281, Ext. 633. Applications from men and women, in the form of a curriculum vitae, including the names and addresses of three referees, should be sent to the same address by 26 April, 1985 quoting the reference 370/N8.

FBC

FBC Limited is an international company in the field of agrochemicals and livestock products, with a strong research base and certain industrial chemical interests. It has a leading position in the British market, associated companies in a number of overseas countries and an annual turnover in excess of £100 million.

Organic Chemists

Nr. Cambridge

We currently have opportunities for Ph.D. Chemists to join our Chemical Synthesis Group at Chesterford Park Research Station, which is situated between Saffron Walden and Cambridge.

As part of a team engaged in agrochemical research, you will be expected to design and synthesise a wide variety of organic molecules for biological evaluation. You will have use of the most up to date spectroscopic and chromatographic facilities, as well as computer aided molecular modelling and synthesis design programs.

You should have a proven record of post graduate research, demonstrating excellent practical ability and a wide knowledge of organic chemistry. For one post an interest in HPLC and structural elucidation of complex molecules would be an advantage.

We offer competitive salaries supported by a substantial range of fringe benefits normally associated with a major international company, including relocation expenses where appropriate.

These appointments are open to both men and women.

Please send curriculum vitae, quoting ref: CP9999 to E. J. Flint, Personnel Manager, FBC Limited, Chesterford Park Research Station, Saffron Walden, Essex CB10 1XL.

FBC Limited is a subsidiary of Schering AG, West Germany.



UNIVERSITY OF LEICESTER

Department of Geology
LECTURESHIP IN MINERAL
EXPLORATION GEOPHYSICS

Applications are invited for a 'New Blood' Lectureship in Mineral Exploration Geophysics in the Department of Geology tentable from 1 October, 1985. The age of the successful candidate should not normally exceed 35 at the date of appointment.

The successful candidate would be expected to have a PhD in Physics or Geophysics and concentrate his/her research efforts in the development of field procedures, data processing, and quantitative interpretation schemes for electrical and electromagnetic prospecting methods.

Initial salary will depend on qualifications and experience on the Lecturers' Scale £7520 to £14 925.

Further particulars from the Registrar, University of Leicester, University Road, Leicester LE1 7RH, to whom applications should be sent on the form provided by 30 April, 1985.

Oilfield
EXPERT SYSTEMS LIMITED

Petrophysicist or Geologist with LISP experience needed for oil-company project in Glasgow. Top remuneration. Tel: D. Hawkins (0446 5105).

Fulmer Research Laboratories

require a

PHYSICIST

We are anxious to recruit a new or recent Graduate with a first or upper second class Honours Degree in Physics, to join a small team engaged in Research and Development project work involving ultrasonics, electronics and computer based systems.

Experience in practical electronics acquired as part of an industrial training period or as a hobby, is essential.

The appointment will commence July 1985.

Applicants should apply in writing enclosing a full curriculum vitae to:

Eileen Adams
Fulmer Research Laboratories Ltd
Hollybush Hill
Stoke Poges
Slough SL2 4QD

Agricultural and Food Research Council

FOOD RESEARCH INSTITUTE

Nutrition and Food Quality Division

Sensory Quality and Food Acceptance Group

SENSORY SCIENTIST

Scientific Officer/Higher Scientific Officer

There is a vacancy for a Sensory Scientist to work in the Sensory Quality and Food Acceptance Group on studies of the relation between the perceived quality of sensory and their physical and mechanical properties. The duties of the post are concerned with the provision of the sensory input to such studies, the primary aim of which is to produce a fundamental understanding of the nature of natural perception of foods.

Qualifications

A first or upper second class honours degree in a Biological Science. An interest in foods and the sensory perception of foods is essential. A food scientist with experience in sensory evaluation who has the ability to develop the biologically based aspects of the work would also be considered. A sound appreciation of statistical techniques and interest in multivariate methods is highly desirable. At least two years relevant post graduate experience required for appointment to the higher grade.

Salary scales

Scientific Officer: £5600-£8153
Higher Scientific Officer: £7428-£10 029
Non-occupational superannuation scheme
The Agricultural and Food Research Council is an Equal Opportunities Employer.
Further particulars and application form from the Secretary, Food Research Institute, Clonville Lane, Norwich NR4 7UL, quoting Reference 84/33
Closing Date: 11 April 1985

UNIVERSITY OF SOUTHAMPTON Chemical Pathology and Human Metabolism

TEMPORARY RESEARCH ASSISTANT

Applications are invited for the above post which is for a six months only, and involves the analysis of cadmium in biological materials using atomic absorption spectrophotometry. The temporary appointment would offer suitable experience of analytical techniques to a new graduate in chemistry or a related science. The salary a further will be up to £7055 pa. Further information may be obtained from Dr H. T. Delves (Southampton 0703-777222, Ext 3846). Applications to include cv and the names, addresses and telephone numbers of two referees should be sent to Mr A. J. Small, Staffing Department, The University, Southampton SO9 5NH. Please quote Ref No. AHS/85/19/NS.

THE NATIONAL INSTITUTE FOR MEDICAL RESEARCH

TEMPORARY TECHNICIAN—(SIX MONTHS)—£6381 pa

Required to join a group from 1 May using a combination of neuroanatomical and biochemical techniques to examine central nervous system function. Experience with tissue culture, standard biochemical techniques, and use of laboratory rodents desirable.

To apply for a position, please Tel 01-958-3666, Ext 221 or write to Mrs P. A. Wilde, Personnel Officer, NIMR, The Ridgeway, Mill Hill, London NW7 1AA. Quoting ref TT/N.

NORTH DEVON HEALTH AUTHORITY

SENIOR HOUSE OFFICER

In Geriatrics required for the North Devon District Hospital. This post is approved for GP vocational training and is suitable for those arranging their own rotation. Commencing 1 August, 1985, for a period of 6 months. Accreditation available. Application forms from the District Secretary, North Devon District Hospital, Raleigh Road, Barnstaple, N. Devon. Closing date: 13 April, 1985.

GET THAT JOB

A professionally prepared cv could secure you that vital interview. Details from Dane Services 0721-66602.

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50 Lincoln Inn Fields, London WC2.

SSC

University of Edinburgh Department of Mechanical Engineering Lectureship

Applications are invited for a lectureship in the general area of CAD/CAM and robotics. The successful candidate will be expected to have preferably a PhD degree and have a demonstrated record of achievement in research in the area of computer-aided engineering and/or associated industrial experience.

There is increasing collaboration between Mechanical Engineering and other Departments at the University engaged in related research. Close ties are also maintained with a number of major industrial firms who are interested in the application of the results of the research in robotics in the Department.

The new lecturer will be encouraged to foster the development of these research and industrial links.

Applications, with the names and addresses of three referees should be sent by 2 May, 1985.

The Secretary, University of Edinburgh, Old College, Edinburgh from whom further particulars may be obtained. Informal enquiries can be obtained from Professor McGough 031-467-1081 ext 3350. Please quote Ref No 1177.

NATIONAL INSTITUTE FOR BIOLOGICAL STANDARDS AND CONTROL

Technician

£6822-£9180 inclusive

The Division of Viral Products requires a Technician to assist in the control of virus vaccines. Experience in virology would be an advantage.

Applicants should be qualified to degree level in microbiology, biochemistry or immunology.

Salary scale £6822-£9180 including London Weighting allowance of £1084. Starting point would be dependent upon age, qualifications and experience.

Please write or telephone for further information and an application form, quoting Ref No VP/098 to the Personnel Office, NIBSC, Holly Hill, Hampstead, London NW3 6RB. Tel 01-435 2232.

MALVERN

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A small progressive company of approximately 65 staff making laser based measurement systems for world wide sale. The equipment employs Optical Systems coupled to electronic Signal Processors and Personal Computers to create a complete measurement tool. They are designed in-house often with co-operation from Universities and other Research Centres. The working environment is high paced and your contribution will be rapidly visible in our aims for continuing growth. The company is expanding by a continuous programme of development and diversification.

Thus we require staff for the following posts

SENIOR SYSTEM ENGINEER having

- * Degree (or equivalent) in Physics, Computer Sciences, Electronics etc.
- * Experience of light scattering based measurement techniques.
- * Ability to programme PCs to stimulate and create systems.
- * Ability to specify and understand electronic sub-systems.
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SENIOR DEVELOPMENT ENGINEER having

- * Degree (or equivalent) in Electronics, Physics, Computer Science etc.
- * Experience of Scientific Instrument development.
- * Ability to design complex analogue and digital circuitry.
- * Ability to programme the latest 16bit Personal Computers.
- * High motivation, organisational ability and drive.

JUNIOR DEVELOPMENT ENGINEER/TECHNICIAN having

- * HNC/HND/Degree in Electronics, Physics, Computer Sciences etc.
- * Interest in assembly of prototype electronics based systems.
- * Ability to construct and debug analogue and digital circuits.
- * Experience of BASIC language programming.
- * Interest in ensuring prototypes are successfully productionised.

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If you are interested in our opportunities please apply in writing with a cv enclosed to:

Mr D. J. Watson, R&D Manager, Malvern Instruments, Spring Lane, Malvern, Worcs WR14 1AL

or, initially ring on 068-45-3531



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Consultancy Limited

OCEANOGRAPHIC CONSULTANT

METOCEN Consultancy Limited is an independent company engaged in providing the energy and civil engineering industries with advice, specification, supervision of data gathering programmes, technical audits of reports, evaluation of design and operating criteria and liaison with certifying authorities.

To assist in its continued growth METOCEN requires a Senior Consultant with postgraduate qualifications in oceanography or ocean engineering. The successful candidate will be at least in his early thirties and probably will have worked in the commercial sector for some time in his career. He will have had substantial experience of data analysis and interpretation combined with some field work and data collection. A knowledge of numerical modelling will be an advantage.

Although based in Malvern, the Senior Consultant will, at times, be expected to work in a client's office or on a coastal or offshore project, both in the UK and overseas.

The part offers attractive salary and fringe benefits.

Write with curriculum vitae to:

Managing Director
METOCEN Consultancy Ltd
Longpound House, Malvern
Bury St Edmunds, Suffolk

University of Bristol Remote Sensing Unit (Dept of Geography)

Applications are invited for the post of

Temporary Research Assistant

to work under the guidance of Dr E. C. Barrett as a member of a small team addressing a number of satellite remote sensing contracts. The appointee will be a young graduate with experience of weather satellite image analysis, and familiarity with digital image processing. Some knowledge of climatology and/or meteorology will be required.

The appointment will be at the IB level, initially for six months, but with a possibility that this period could be extended. The salary scale is £5600 pa (under review).

Applications, together with the names of three referees, should be received not later than 12 April, 1985, by The Director, Remote Sensing Unit, Department of Geography, University of Bristol, Bristol BS8 1SS, from whom further particulars may be obtained.

Systems Design Engineer

A real Career opportunity for a Graduate in Electronic Engineering or Physics has arisen in Renishaw Research Ltd which is building a fully professional team to develop Advanced Manufacturing Systems. The opening is for a **SYSTEMS DESIGN ENGINEER** with at least five years post graduate work in R & D including design of computer interfaced electro-optical systems, and of electromechanical systems. Familiarity with micro computer capability and BASIC programming is essential. The work is in an inter-disciplinary environment and is part of one of the fastest growing Companies in the UK.



RENISHAW



Based in our new R & D facility in Wotton-under-Edge, the post combines the delights of working in a Cotswolds setting, with very easy access to Bath, Bristol and Gloucester. Salaries are realistic with good benefits. Relocation assistance is possible. Please apply to R. S. Roberts, Group Personnel Manager, Renishaw plc., Gloucester Street, Wotton-under-Edge, Gloucestershire, GL12 7DN. Telephone (0453) 842533.

UNIVERSITY OF LIVERPOOL 'NEW BLOOD' LECTURESHIP IN SEMICONDUCTOR MATERIALS
Applications are invited for the post of Lecturer in the Department of Metallurgy and Materials Science, established under the UGC 'New Blood' Initiative and tenable from 1 October, 1985. Candidates should normally be aged 35 or under on appointment. Persons holding permanent university appointments in the UK, of whatever kind, are ineligible for appointment to this post. New Blood appointments will be primarily for research.

This post has been created to promote research into the materials aspects of semiconductors and microelectronics, including silicon, compound Semiconductors, superlattices, metallization, packaging and optical materials. Applicants should have a strong research record in materials science relevant to the microelectronics industry. Initial salary on the scale £7320-£14 925 pa.

Application forms and further particulars may be obtained from The Registrar, The University, PO Box 147, Liverpool L69 3BX, by whom completed forms should be received not later than 30 April, 1985. Quote Ref: RV/995 (b).

MRC MEDICAL RESEARCH COUNCIL
Medical Research Council

Laboratory of Molecular Biology, Cambridge

RESEARCH ASSISTANT

Applications are invited from graduates with at least three years' research experience to work on a project led by Dr A. Skipp on the structure of chromatin and the interaction of a regulatory protein with DNA. Experience in protein and/or nucleic acid chemistry would be an advantage but relevant experience in other areas of molecular biology or biochemistry will be taken into consideration.

The post is available for three years and the salary will be in the range £7530-£11 120. Further information from The Assistant Director (Cambridge) 0223 248011.

Applications requiring a full CV and the names of two professional referees should be sent by three weeks after appointing a quoting reference BL/6 to The Assistant Director (Administration), MRC Laboratory of Molecular Biology, Hills Road, Cambridge CB2 2QH.

Institute of Cancer Research and Royal Marsden Hospital Joint Department of Physics

RESEARCH IN MEDICAL PHYSICS AND ENGINEERING 5 Postdoctoral Posts

As a consequence of new funding for a 6-year research programme we wish to appoint five physical scientists to research positions in the following areas:

1. Detector development for radiostereographic imaging techniques, initially based on the use of positron emitters and multi-wire proportional chambers.
2. In vivo characterisation of pathology using ultrasonic methods, in coordination with similar work based on NMR imaging.
3. Development of new radiation detectors and imaging systems, including CT, to be integral with S-25MV therapy linear accelerators.
4. Development of new methods for computing and applying radiation treatment doses, including Dynamic Therapy, in a 3-dimensional framework.
5. X-ray imaging techniques, particularly with application to breast cancer diagnosis and to digital chest radiography.

Relevant experience is desirable but not essential: more important will be evidence of inventiveness and ability to carry out original research. It is intended to make immediate appointment to most of the vacancies but we shall also be glad to hear from candidates interested in appointments later in the year.

The appointees will be joining 30 existing scientific staff members in a combined research and service department with a wide variety of interests in applying the methods of physics and engineering to problems of cancer and working within an excellent multi-disciplinary medical research and teaching environment. Posts 1-4 will be based at our Sutton, Surrey campus and post 5 in Chelsea.

Starting salaries will reflect qualifications and experience and will be on MRC non-clinical scientific scales CB920-C11 675 pa plus London Allowance of £1233 pa. Appointments will be for three years in the first instance with opportunities for subsequent renewal.

Applications, in duplicate, should include the names and addresses of two professional referees, and should be submitted not later than 19 April to the Personnel Officer, Institute of Cancer Research, 17A Oaklaw Gardens, London SW7 3AL, quoting Ref 390/G/B. Informal enquiries will be welcome and should be addressed to Professor C. R. Hill, Physics Department, Royal Marsden Hospital, Sutton, Surrey, Tel 01-442 6011.

Applicants are advised that in the majority of the Institute's premises smoking is prohibited.

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE

Journal of Tropical Medicine and Hygiene and Health Policy and Planning

EDITORIAL ASSISTANT

An editorial assistant is required to deal with the editorial, secretarial and administrative work for this bi-monthly journal published by the London School of Hygiene and Tropical Medicine. Candidates should have practical editorial experience, good secretarial and organisational skills and be able to work largely unsupervised. Routine tasks are computerised, while editing papers will be a major activity. Previous editorial experience with a medical journal would be an advantage. An interview on Health Policy and Planning in the Third World is also being launched by the School and the editorial assistant will preferably work for both journals, when the post will be negotiable around three-quarters time. Salary will be proportionate to time worked, on a full-time scale upwards from £8000 plus London Weighting according to experience. Please write with full details of qualifications and experience and the names of two referees to the Assistant Personnel Officer, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT. Closing date: 15 April, 1985.

UNIVERSITY OF MANCHESTER

Department of Diagnostic Radiology

RESEARCH TECHNICIAN

The Department has four imaging suites including Magnetic Resonance Imaging, Computed Tomography (Body Scanning), Ultrasound and Angiography. Current research is concerned with the development of new non-invasive techniques. Animal care and husbandry are important aspects of the work. The post offers considerable scope for initiative and the ideal candidate will have a background in biological sciences and an ability to program. Previous imaging experience desirable.

Candidates should possess HNC or equivalent in addition to several years' relevant experience. Salary scale £5851-£7684 (under review). Applications with full details of age, experience and qualifications and two referees to Professor I. Ingherwood, Department of Diagnostic Radiology, Medical School, University of Manchester, Oxford Road, Manchester M13 9PT.

MEDICAL RESEARCH COUNCIL Dunn Nutrition Unit

TECHNICIAN

To participate in a study of nutrient requirements of infants during the weaning period. The work will be primarily laboratory-based and experience of immunological or enzyme techniques will be an advantage. In addition the successful candidate will be expected to undertake work in the community and to spend two-three months a year at our field station in The Gambia, West Africa.

The post is for a period of three years.

Candidates must have a degree, HNC or equivalent qualification.

Salary will be according to age and experience in the range £5738-£8096.

Write with full cv and names of two professional referees to the Administrative Officer, Dunn Nutrition Unit, Downham's Lane, Milton Road, Cambridge.

Closing date (three weeks from publication).

Senior R & D Manager

Fluid Mechanics

NMI Ltd., is a commercial research and development organisation which specialises in problems related to hydrodynamic and aerodynamic engineering. We will shortly be merging with BSRA to offer the most comprehensive maritime research capability in the UK. Far from restricting our activities to maritime matters, however, we will continue to undertake consultancy and research projects across a wide range of fluid mechanics areas.

In particular, we are urgently seeking an experienced engineer/scientist to manage our Applied Fluid Mechanics Division. Based at Taddington in Middlesex, this Division performs work for Industry and Government in various areas of wind engineering and fluid mechanics research and their applications. The Division Head will be responsible for all aspects of the Division's performance and will be expected to contribute to the management and development of the company as a whole.

The successful candidate will have a proven record in a relevant branch of applied fluid mechanics. This could include areas such as combustion, internal flows or acoustics which are presently outside the mainstream of the Division's activities, as an important part of the work will be to lead expansion into new fields. Previous experience of managing technical specialists and dealing with client-initiated consultancy and research would also be a considerable advantage.

An attractive benefits package will be offered, including a company car, low-cost pension scheme, and relocation assistance if necessary.

To apply, please send brief career details in the first instance to: Mrs. S. Nicholson, Personnel Manager, NMI Ltd., Faggs Road, Feltham, Middlesex TW14 0LQ. Tel: 01-890 8989.



WESSEX WATER SENIOR SCIENTIST MICROBIOLOGY

Salary Grade 7A £10 500-£13 029

Applications are invited from suitably qualified persons for this new post in the regional scientific structure to be based at Salford Laboratory, near Bristol.

The person appointed will be responsible to the Principal Scientist Laboratory for ensuring the day to day management of the bacteriology laboratories at Salford and Trowel and providing a regionally based microbiological service throughout the water cycle but principally in water supply.

Applicants must be prepared to work the extended hours agreement recently negotiated at the laboratory and to take charge of all the laboratory services from time to time.

Applicants must be qualified to degree level in microbiology, have considerable experience in the practical application of microbiology, preferably in its use with regard to water supply.

Application forms and job descriptions are available from the Personnel Officer, Wessex Water Authority, Wessex House, Passage Street, Bristol BS2 0SQ. Tel: Bristol 200411 Ext. 212. Closing date for applications: Friday 12 April 1985.

Information Scientist

Thornston Research Centre near Chester is one of Shell's major laboratories, with some 700 employees. We have a worldwide research programme related to energy problems, and are involved in the development, testing and use of fuels and lubricants which includes fundamental studies of combustion, lubrication and surface behaviour. Other work includes general engineering with special emphasis on materials science particularly as applied to the extraction, handling and application of hydrocarbon feedstocks or energy sources.

We are currently seeking an Information Scientist to work in our Technical Information Section. You will be one of a small team responsible for the collection, classification and retrieval of information relevant to the scientists and managers of the Research Centre.

Because of the scientific nature of the work in progress at Thornston Research Centre, ideally, you should have a degree in Chemistry, Physics or Engineering.

You should also have over three years experience in a specialised library environment or post graduate qualification in information librarianship and be familiar with modern information technology.

We offer a competitive salary, 25 days holiday and assistance will be given with re-location expenses where appropriate. Other benefits include an excellent contributory pension fund and a free staff restaurant. If you are interested, please write or telephone for an application form to: Mrs J. K. Davis, Shell Research Limited, Thornston Research Centre, P.O. Box 1, Chester CH1 3SH, tel: 051-373 5788.



THE UNIVERSITY OF LEEDS DEPARTMENT OF MICROBIOLOGY "NEW BLOOD" LECTURER

Applications are invited for the above post allocated under the UCL's New Blood Scheme and available from 1 September, 1985. The post was awarded for biochemical investigations on the mode of action of antifungal drugs. Applicants should have a good honours and postgraduate degree in an appropriate area and a proven record in biochemically-based research on fungi.

The age limit for "New Blood" post is 35 but marginal exceptions may be made.

Salary on the academic scale for Lecturers (£27530-£41925) (under review) according to age, qualifications and experience.

Application forms and further particulars may be obtained from the Registrar, The University, Leeds LS2 9JT, quoting reference no. 94/57. Closing date for applications 9 May, 1985.

UNIVERSITY OF LEICESTER

Department of Adult Education

Applications are invited for the following two posts: (i) Organising Tutor, University Centre, Northampton; (ii) Organising Tutor, Northamptonshire.

Candidates should be qualified in one of the following subject areas: Earth Science, Botany, Social Geography.

Initial salary will depend on qualifications and experience on the scale £7520 to £14 925.

Further particulars from the Registrar, University of Leicester, University Road, Leicester LE1 7RH, to whom applications should be sent on the form provided by 26 April, 1985.

THE UNIVERSITY OF MANCHESTER RESEARCH BIOCHEMIST IN THE

DEPARTMENT OF MEDICINE
Applications are invited for this post in Hope Hospital to work on aspects of the biochemical control of intestinal secretion. The appointee will work in a team headed by Dr G. Warburton. The post is financed by the Sir Jules Thorn Charitable Trust and is available for 12 months in the first instance. Salary range pa: £7520-£8920. Superannuation. Applications to include a full cv and the names of two referees, to Professor L. A. Turnberg, Department of Medicine, Hope Hospital, Eccles Old Road, Salford M6 8HD by 16 April, 1985.

Spectrographer

Johnson Matthey Chemicals is a leading refiner of precious metals and a manufacturer of high purity chemicals and related products. Our large well equipped Analytical Laboratory helps us to maintain our reputation for excellence.

We now require a Spectrographer to join our Analytical Laboratories to perform analysis and development work, primarily on DC Arc atomic emission. The work involves a wide variety of inorganic materials and covers determination to sub ppm levels on high purity materials.

It is likely that the successful candidate will be educated to HNC or degree level and will ideally have two years practical experience in a relevant environment.

The appointment is based at Royston, North Hertfordshire; is open to both men and women and carries a competitive salary and a range of benefits, including relocation, associated with a progressive employer.

Please apply for an application form from the Personnel Manager, Johnson Matthey Chemicals Ltd., Orchard Road, Royston SG8 5HE. Tel. (0763) 44161.

JMC

SOUTH MANCHESTER HEALTH AUTHORITY Wythenshawe Hospital CLINICAL PERfusionIST (MPT III/IV)

The successful applicant will be part of a team of six clinical perfusions and will primarily be concerned with the running of heart lung machines and associated equipment.

For appointment to Grade III, applicants must possess an 'O' Tec in medical physics and physiological measurement or equivalent and have three years' relevant experience. Applicants having lesser qualifications or experience appointment to Grade IV or Junior Technician is possible.

Salary: £5408-£8283 pa—Grade III: £5404-£7104 pa—Grade IV under review.

Informal enquiries to Dr M. A. Tobias, Consultant Anaesthetist, Ext 157/Mr R. Marples, Chief Technician, Ext 716. Job description and application form from unit administrator. Tel 061 996 7070, Ext 141.

Scientists

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DEPARTMENT OF AGRICULTURE FOR NORTHERN IRELAND and THE QUEEN'S UNIVERSITY OF BELFAST CHAIR OF AGRICULTURAL BOTANY

Applications are invited for the combined post which is now vacant of Head of the Agricultural Botany Research Division of the Department of Agriculture and Professor of Agricultural Botany in the Faculty of Agriculture and Food Science, The Queen's University of Belfast.

Candidates should be well qualified in Agricultural Botany, Agricultural Genetics or a relevant discipline, have extensive experience in teaching or research and have a sound knowledge of the agricultural industry.

The appointment will be made within the scale for Deputy Chief Scientific Officer in the Department which is £20,013-£24,317. The starting point will be related to qualifications and experience. There is a pension scheme which is non-contributory apart from 1½% deduction from salary to cover widow's and dependants' benefits.

An application form and further details of the post can be obtained from the Secretary, Civil Service Commission, Rosset Park House, Upper Newtownards Road, Belfast BT4 3NR (Telephone Dundonald (02318) 4567, Extension 583). Please quote reference SB 3785. The closing date for receipt of completed application forms is 3 May 1985.

The Northern Ireland Civil Service Commissioners may decide to interview only those applicants who appear from the information available to be best qualified.

THE UNIVERSITY COLLEGE OF WALES ABERYSTWYTH LECTURESHIP IN PLANT BIOCHEMISTRY

Applications are invited from scientists with research interests and experience in the role of carbohydrates in one of the following areas:—

- cell growth
- cell metabolism
- cell-cell recognition

In accordance with the terms of the 'New Blood' initiative, candidates should normally be aged under 35 or under, and in the early years the primary role will be to contribute substantially to research. The post is to be held in the Department of Biochemistry and Agricultural Biochemistry, School of the scale for Lecturers £7520 to £14 925 per annum.

Application forms and further particulars can be obtained from the Staffing Officer, The University College of Wales, Old College, King Street, Aberystwyth SY23 2AX (Tel 0970 3177, Ext 2071). Closing date for applications: Friday, 22 April, 1985.

UNIVERSITY COLLEGE LONDON Department of Computer Science RESEARCH TECHNICIAN

Applications are invited for a post as technician at the Department of Computer Science. The work will involve the installation, maintenance and management of an Ethernet with 16/32 bits workstations and specialised servers. The applicant is also expected to assist in the day-to-day running of DEC PDP-11 and VAX hardware. Applicants with experience in some of these areas will be preferred. Grant supported post.

Salary on scale £8786-£10 285 inc. LA. Applications should be sent to Departmental Secretary, Department of Computer Science, University College London, Gower Street, London WC1E 6BT before 15 April, 1985.

UNIVERSITY OF LEICESTER OPEN RESEARCH SCHOLARSHIP

Applications are invited for the University's Open Research Scholarship tenable for up to three years from 1 October, 1985.

The Open Research Scholarship is tenable in any of the University's departments and carries an annual maintenance award of £2585 (under review) plus remission of fees. The successful candidate will be expected to register for a research degree within the University.

Further details and application forms are available from the Registrar (Open Research Scholarship), University of Leicester, University Road, Leicester LE1 7RH, to whom applications should be returned by 3 May, 1985.

THE UNIVERSITY COLLEGE OF WALES ABERYSTWYTH LECTURER IN ECOLOGY

Applications are invited for the above temporary post which is tenable in the Department of Botany and Microbiology for a fixed term of two years from 1 September, 1985. Preference will be given to applicants with interests in applied ecology and in particular to those with experience in dune and reclamation. The appointment will be made on the scale for Lecturers within the range £7520 to £10860 per annum.

Further particulars and application forms can be obtained from the Staffing Officer, The University College of Wales, Old College, King Street, Aberystwyth SY23 2AX (Tel 0970 3177, Ext 2071). Closing date for applications: Friday, 12 April, 1985.

Thin Film Technologist

ERA is a highly successful independent contract research organisation serving clients world-wide. Increased demand for services has created a need for additional staff to tackle an extremely interesting range of projects in the field of vacuum deposition of thin films.

Thin film deposition techniques are developed and exploited to solve coating problems and provide novel devices for diverse applications. There is exceptionally wide scope and opportunity for innovation in a challenging environment.

We are seeking an able graduate with relevant experience to contribute to this work. As well as an aptitude for creative research and problem solving, the ideal candidate will be able to generate new ideas, have commercial awareness and possess the ability to communicate effectively. The laboratories are modern, well equipped and located in pleasant surroundings.

Competitive salary and excellent range of benefits that may include generous assistance with relocation.

Please apply to the Personnel Manager, ERA Technology Limited, Cleeve Road, Leatherhead, Surrey, quoting reference 22/42.

ERA
TECHNOLOGY

Senior Principal Research Officer Solomon Islands

The officer will be responsible for the planning, implementation, analysis and interpretation of the Government's Research Programme on tree crops, and the carrying out of coconut genotype and agronomy experiments in various environments in the Solomon Islands.

Candidates should be British Citizens, aged 30-80, and possess a degree in Agriculture, Biological Sciences or equivalent together with a post-graduate degree/diploma in an appropriate subject. A minimum of five years experience conducting an agronomy programme with tropical crops is required.

The appointment is on contract to the Government of the Solomon Islands for a period of two years. Local salary in the range \$4570 to \$5584 (Solomon Islands \$) pa, plus a tax free supplement payable by ODA, in the range £10,000 to £13,294 pa. Other benefits include free passages, children's education allowances and subsidised accommodation. A terminal gratuity of 25% of local salary may also be payable on satisfactory completion of the contract.

Exchange rate as at 22/2/85 - £1 = \$5.622.

For full details and an application form, please apply quoting ref AH312/JM/NS, giving details of age, qualifications and experience to: Appointments Officer, Overseas Development Administration, Room 361, Abchurch Lane, Eastcheap Road, EAST LONDON, Glasgow G78 8EA.



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UNIVERSITY OF SOUTHAMPTON

Department of Biochemistry 'NEW BLOOD' LECTURES IN MOLECULAR GENETICS

Applications are invited for the above position which has been granted to the department as a 'New Blood' appointment. The post will involve the teaching of Biochemistry and Molecular Genetics to science and medical students, and it is hoped that the research interests of the successful applicant will complement the department's existing studies on the structure and function of membrane proteins. The applicant should have two-four years post-doctoral research experience in Molecular Genetics. Candidates may not hold a permanent University appointment in the United Kingdom, of whatever kind.

Salary scale: £7630-£14 628 pa. Further information about the above post and about the Biochemistry Department may be obtained from Professor M. Akhtar, FRB, Department of Biochemistry, University of Southampton, SO9 3TU.

Further particulars may be obtained from Mr A. J. Small, Staffing Department, The University of Southampton, SO9 5NH, to whom applications (seven copies from applicants in the United Kingdom and one from others) giving a brief CV and the names, addresses and telephone numbers of three referees should be sent before 19 May, 1985. Please quote ref: A.78/85/21/NS.



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A scientist in the field of real-time image processing, with knowledge of software development for micro-processors. The candidate must have at least an MS degree as well as industrial or research experience.

A scientist in the field of Artificial Intelligence with experience in industrial applications and with a good knowledge of languages such as LISP and PROLOG. The candidate must have an MS degree or PhD. Industrial experience to conduct surveys and establish relations with industry would be an advantage.

Please address applications, including curriculum vitae, to:

The Personnel Manager
Battelle, 7 route de Drize
CH-1227 CAROUGE/
Geneva-Switzerland.

UNIVERSITY OF OXFORD

Inorganic Chemistry Laboratory SENSORS AND SURFACES

A number of post-doctoral research positions are available in the Inorganic Chemistry Laboratory, Oxford to work on a variety of aspects of sensors and surfaces. The aim is to prepare new materials, in particular, new modified surfaces, to explore the use of organometallic, organic and coordination compounds in such modifications, and to use spectroscopic methods such as Fourier Transform Infra-red Spectroscopy to achieve an understanding of the nature of the modified surface. The surfaces will be examined for their possible application in sensors, in particular, novel biosensors, and also for their ability to elicit new electronic properties. The projects form the basis of an extensive collaboration both within Oxford and also with Guy's Hospital, London and the University of Leicester Biosciences Centre. Applications are invited from synthetic chemists (organic, inorganic or organometallic), spectroscopists interested in the properties of surfaces, electrochemists interested in the application of novel materials, and biochemists interested in the appropriation of enzymatic, immunological or molecular biological methods by sensor technology. Further details can be obtained from The Administrator, Inorganic Chemistry Laboratory, South Parks Road, Oxford, OX1 3QR, to whom applications should be sent as soon as possible.

Pharmaceutical Formulation and Analytical Technicians

Nr Uxbridge, Middlesex c. £7,500

We are Glaxo Animal Health Limited, responsible for the Group's veterinary and animal healthcare business on a worldwide scale.

Our new Pharmacy Unit has been established to provide a dedicated pharmaceutical resource to meet the veterinary research and development requirements of the company. We now wish to appoint both a Formulation Technician and an Analytical Technician to assist in the pharmaceutical development of new and existing veterinary products.

These Technicians will join a pharmacy team which is involved in all stages of product development, including pre-formulation studies, analytical method development, provision of information for registration purposes, manufacture and quality control of both sterile and non-sterile final trial material, and process development.

The successful candidates will be willing to learn new techniques, and should be capable of working independently under the general guidance of a Pharmacist or Pharmaceutical Analyst. The ability to work accurately and meticulously is essential.

Candidates for the position of FORMULATION TECHNICIAN should hold a diploma in the Science of Medical and Cosmetic Products, or similar. Experience within a pharmaceutical or hospital environment would be an advantage.

Candidates for the position of ANALYTICAL TECHNICIAN should hold a Higher Technical Certificate, or equivalent, in chemistry. Experience within an analytical environment is essential.

The company, situated in rural surroundings but only 5 minutes from Uxbridge centre, is offering an attractive salary plus Outer London allowance and bonus scheme. A non-contributory pension scheme, 22 days' annual holiday and staff canteen are some of the generous range of benefits.

For an application form please telephone: Mrs MA Model, Company Personnel Office, Glaxo Animal Health Limited, Breakspoor Road South, Harfield, Uxbridge, Middlesex UB9 6LS. Telephone: Ruislip (089 56) 30266.

Glaxo Animal Health Limited

The Queen's University of Belfast

Research Assistant

Department of Applied Mathematics and Theoretical Physics

This post involves research in theoretical atomic and molecular physics on atomic and molecular processes which are important in fusion research, astrophysics and the physics of the earth's upper atmosphere. The research will make extensive use of a Departmental AX 11/750, a University ICL dual 286 and a CRAY-1S at the University of London Computer Centre. Applicants must have a good Honours Degree and preferably a PhD in Physics or Applied Mathematics and research experience in the development and use of large scientific computer packages. A knowledge of the atomic and molecular processes in the earth's upper atmosphere would be an advantage.

Commencing salary in the range: £7511-£9922 per annum, initial placement depending on age, experience and qualifications. The post is available for 1 April, 1985-31 December, 1987.

Applications, including curriculum vitae and the names and addresses of two referees should be sent to the Personnel Officer, The Queen's University of Belfast BT7 1NN, Northern Ireland. (Please quote Ref 85/QJ)

TECHNICIAN (Grade 3)

required in Department of Microbiology University Reading, to prepare and supply materials for classes and research, and to assist in research. Previous Microbiology experience essential. Salary in scale £5390-£6325 pa. Further details and application form available from Personnel Office, University of Reading, Whiteknights, RG2 2AH. Please quote Ref. T09A.

ROYAL POSTGRADUATE MEDICAL SCHOOL

(University of London)

Department of Medicine

MRC Clinical Immunology Research Group

TECHNICIAN

A three year technician post is available funded by the Leukemia Research Fund. The appointee will work on a study of the pathogenesis of Cytomegalovirus infection in the bone marrow transplant population, using immunological techniques and DNA hybridisation. Salary will be on range £5795 to £8177 plus £1084 London Allowance pa.

Application forms and further particulars may be obtained from the Personnel Office, Royal Postgraduate Medical School, 100 Du Cane Road, London W12 0BS quoting ref 2/JOPS. Closing date 11 April, 1985.

UNIVERSITY OF EDINBURGH

RESEARCH TECHNICIAN

required for the DEPARTMENT OF PHYSIOLOGY, Medical School, Teviot Place, to assist Dr R. H. Ritchie in an MRC project on the formation and regeneration of nerve-muscle connections. Experience with tissue culture and knowledge of histological methods are essential. MRC, SCOTEC Postgraduate Medical School, 100 Du Cane Road, London W12 0BS. Salary in range £6581-£7684. The position is granted funding for two years from May 1985. Applications should include the names and addresses of two referees and should not be later than 18 April, 1985 Ref NS 501.

Further details, where available, the application forms may be obtained from the Personnel Office, University of Edinburgh, 43 South Bridge, Edinburgh, EH1 1LS Tel 031 555 2920 (24 hour answering service)

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CHARING CROSS & WESTMINSTER MEDICAL SCHOOL

(University of London)
RESEARCH GRADUATE IN IMMUNOLOGY

Interesting work, primarily in fluorescence activated cell sorting for the Westminster Bone Marrow Team, related to immunodeficiency, blood disorders, oncology (drug targeting), genetic diseases and cell cloning, etc. Salary (incl. London Weighting) within range £6753-£13 383 according to experience. Applications (post-doctoral preferred) with three referees to Professor J. R. Hobbs, Westminster Hospital, 7 Page Lane, W1P 2AR. (Tel 01-828-9811) by 28 April, 1985.

CAMBERWELL HEALTH AUTHORITY

King's College Hospital PART-TIME BASHORDEMI-RO is required for our Medical Microbiology Department. The post involves routine work in a busy diagnostic laboratory. 22 hours per week over four days, plus one in four Saturday mornings.

Salary: £4055-£5458 pa. inc.

Application forms and job description are available from The Unit Personnel Department, King's College Hospital, Denmark Hill, London SE25 8RS. Tel 01-274 6222. Ext 2254/2571 quoting ref: B1251.

Further information is available from the Senior Chief MISO, Mr F. Ayliffe, Ext 2643.

Closing date: 12 April, 1985.

GRADUATE

We provide market research data to the pharmaceutical industry and need a Graduate with a Life Science Degree or equivalent to assist in the day to day running of an on-line database and maintenance of computer based files.

This ability to work accurately at detailed level is necessary together with an interest in the pharmaceutical industry in general.

Our London office, situated in central London near Euston station and underground stations, offers competitive salary offered together with a discretionary and of year bonus.

Full CV to be sent to: Mrs E. Cooper, International Medical Statistics Ltd, 364 Euston Road, London NW1 3BL.

UNIVERSITY OF LIVERPOOL LECTURER IN INORGANIC CHEMISTRY

Applications are invited for a Lectureship in Inorganic Chemistry, tenable in the Department of Inorganic, Physical and Industrial Chemistry (Professor of Inorganic Chemistry, B. T. Heaton).

Initial salary within the range £7520-£8620 pa on a scale rising to £14 925 pa.

Applications, together with the names of three referees should be received not later than 22 April, 1985 by The Registrar, The University, PO Box 147, Liverpool L69 3BK, from whom further particulars may be obtained. Quote Ref: RV/994/NS.

UNIVERSITY COLLEGE LONDON

Faculty of Clinical Sciences

TECHNICIAN GRADE 3 required to work mornings only in the Museum of the Histopathology Department. Duties will include the mounting of new specimens, maintenance of existing ones and general 'housekeeping' of the museum. A more detailed job description is available on request. Please apply in writing, giving date of birth, date of previous experience and names and addresses of two referees, to Personnel Officer (Technical Staff) GAB, University College London, Gower Street, London WC1E 6BT.

WEST MIDDLESEX UNIVERSITY HOSPITAL Isleworth, Middlesex We require JUNIOR B MISOs for the department of Biochemistry at this large District General Hospital. One of the posts is temporary for 6-8 months to cover maternity leave and another Biochemistry trained would be preferred for this post. Salary Scale £4260-£5683 pa inclusive.

Application form from Mrs P. Egan, Personnel Department, Tel 01 560 2121, Ext 606. Closing date 12 April, 1985.

UNIVERSITY OF BRISTOL

Department of Civil Engineering
Research Assistant in
Civil Engineering

Applications are invited for a research assistant to work on a study of risk, cost and benefit for various treatment strategies for the limestone mines at the West Midlands. The work will involve considerable liaison with industry and is an opportunity to use some of the latest techniques in artificial intelligence and expert systems for risk analysis. The results of the research will aid in actual decisions of the problem. The project is funded by the Department of the Environment.

Applicants should have a degree in Engineering or Science, with a PhD or several years experience in industry. Secondment from current employment for one year could be arranged. Salary range up to £12 635 per annum.

Applications should be addressed to Dr D. I. Bocking, Department of Civil Engineering, University of Bristol, Queen's Building, University Walk, Bristol BS8 1TR.

THE UNIVERSITY OF
MANCHESTERRESEARCH ASSISTANT IN
CELL/DEVELOPMENT
BIOLOGY

Applications are invited for this post in the department of Basic Dental Science, funded by the University's Research Support Committee, for two years in the first instance, to study developmental mechanisms in normal and abnormal palate formation. The work will involve organ culture, cell culture, cell cloning, and immunocytochemistry at light and electron microscope levels. Previous experience in one or more of these techniques would be an advantage. Salary range £6970-£7990 pa. Superannuation.

Enquiries and applications (cv, publication list, and the names and addresses of two referees) to Professor M. W. J. Ferguson, Department of Basic Dental Science, The University, Manchester M13 6PL (Tel 061-2735252) by 16 April, 1985.

UNIVERSITY OF KENT
AT CANTERBURY'New Blood' post for Condensed
Matter Physics

LECTURER IN PHYSICS

Applications are invited for the post of Lecturer in Physics, tenable from 1 October, 1985. Applicants should not normally be over 35 years of age. Preference will be given to experimentalists interested in structure or atomic motion in condensed matter. The successful candidate will be expected to join current research in the Physics Laboratory or develop an innovative programme of research in a related field. Salary will be within the range £7580-£14 000. Application forms and further particulars may be obtained from the Assistant Registrar, Faculty of Natural Sciences, Chemical Laboratory, The University, Canterbury, Kent CT2 7NH. Closing date: 26 April, 1985. Please quote ref A24/85/NS.

CROYDON HEALTH AUTHORITY
Mayday Hospital

AUDIOLOGICAL SCIENTIST

To continue development of the department while undertaking practical procedures within the Clinic.

Post Probations Salary Scale: £5813/£5725 per annum plus £648 London Weighting.

For application form and/or to arrange informal visit, please contact Unit Personnel Department, Mayday Hospital, Tel 61-684 6899, Ext 3721/3530.

TEST ENGINEERS
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VG Analytical Ltd., a world leader in the manufacture of mass spectrometers, requires experienced engineers to join their Test/Installation Department at Manchester.

Ideally applicants should have:-

- A thorough knowledge of modern high vacuum techniques.
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- An ability to work successfully with minimum supervision.
- Detailed practical knowledge of sector field mass spectrometers.
- Less experienced applicants qualified to at least degree level, who wish to take the opportunity of developing a new career, will also be considered.

Based at the company's premises near Manchester, where thorough product training will be given, successful applicants must be willing to travel both within the UK and overseas to install and service the company's products. These positions offer an attractive salary together with all the usual fringe benefits.

Applicants, male or female, should write with full C.V. to:

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Organic mass spectrometry

QUEEN MARY COLLEGE
(University of London)

"New Blood" Lectureships

Applications are invited for the following Lectureships to commence 1 October, 1985. It is not possible to consider candidates who already hold a permanent UK University appointment, or who will be over 35 on 1 October, 1985.

ASTROPHYSICS (Millimetre-Wave Astronomy): The successful candidate will have a record of research achievement in millimetre-wave astronomy and will be expected to contribute to a research programme in the fields of star formation, interstellar chemistry and the structure of evolution of galaxies by (i) continued development of heterodyne receivers and associated instrumentation; (ii) observation using national and international facilities and (iii) data-reduction and theoretical modelling. Ref 85/22/NS

BIO MATERIALS: Based in the Biomaterials/Bioelectronics Group in the Department of Materials. The research programme is centred on studies of the structure and properties of natural tissues, with special emphasis on bone, and of synthetic materials (polymers, composites, metals and ceramics) for prosthetic applications. Applicants should have a PhD in Materials Science or equivalent discipline and appropriate postdoctoral experience either in biomaterials or in relevant topics eg electron microscopy, biocompatibility deformation and fracture mechanics. Ref 85/23/NS

The salary scale for these posts is £7520-£14 925 pa plus £1233 London Allowance, starting point depending on age, qualifications and experience.

For an application form and further details either telephone (01) 980 8748 (ansafone) or write on a postcard to the Assistant Personnel Officer, Queen Mary College, Mile End Road, London E1 4NS, and quote the appropriate ref no. Closing date for return of completed applications is 26 April, 1985.

UNIVERSITY OF LIVERPOOL
Departments of Immunology and
Biochemistry

Applications are invited for the post of
**SENIOR RESEARCH
ASSISTANT**

in the Department of Biochemistry to work on an investigation into gene cloning of human oncofetal antigens defined by monoclonal antibodies. This work has important implications for our understanding of maternal-fetal interactions as well as the process of oncogenesis. This is a postdoctoral position for which experience in recombinant DNA techniques would be a strong advantage.

Initial salary within the range £7520-£8920 pa.

Applications, together with the names of three referees, should be received not later than 18 April, 1985, by the Registrar, The University, PO Box 147, Liverpool L69 3BX, from whom further particulars may be obtained.

Quote Ref: RV/204/NS.

THE UNIVERSITY OF
MANCHESTER

LECTURER IN PHYSICS

The department wishes to appoint a Lecturer with research interests that will reinforce and bring together our present activities in experimental condensed matter physics. Preference will therefore be given to candidates wishing to work on a topic new to the department, but sufficiently closely related to our current interests that existing facilities and expertise would assist rapid and effective progress. The person appointed might, for example, be interested in structural studies that would involve the use of work on liquid crystals and on magnetically ordered materials, or might wish to study new phenomena at millikelvin temperatures and below. Initial salary normally within first four points (£7520-£8920 pa) of Lecturers scale. Superannuation. Further particulars and application forms (returnable by 26 April) from the Registrar, The University, Manchester M13 9PL. Quote ref 62/85/NS.

THE MIDDLESEX HOSPITAL
MEDICAL SCHOOL
(University of London)

Beta Lin Weston Institute of
Neurological Studies

JUNIOR (B) MEDICAL
LABORATORY SCIENTIFIC
OFFICER

A Junior MLSO is required in the electrophysiology laboratory of the Institute to assist in research on the nervous system. A training in all aspects of electron microscopy will be given and previous experience is not necessary. Provision will be made for day release to attend an approved course. Salary in the range £4685-£5247 pa according to age including London Weighting. Applications, including cv and the names of two referees should be sent to the Director, Dr M. J. O. Harrison.

TECHNICIAN (Grade 3)

required in Food Studies, University of Reading, to assist with preparation of classes in relation to Physics and Chemistry and with research activities. Some knowledge of electrical and electronic devices essential. Salary in scale £5399-£6328 pa. Application form available from Personnel Office, Whiteknights House, University of Reading, Whiteknights, PO Box 211, Reading, Berks. RG6 2AR. Please quote Ref. T05A.

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Send a c.v. to David Mitchell, Marconi Secure Radio Systems Limited, Browns Lane, The Airport, Portsmouth, Hants, PO3 5PH or telephone 0705 674420 for an application form. Please quote ref: SR 107.



WILTSHIRE ARCHAEOLOGICAL AND NATURAL HISTORY SOCIETY BIOLOGICAL RECORD CENTRE

Applications are invited for the newly-created post of BIOLOGICAL RECORDER based in Devizes Museum, to establish, develop and maintain a comprehensive biological data-base and information service for the County of Wiltshire.

Applicants should have a good degree in a biological science, relevant work experience, preferably of biological recording and/or survey and a sound knowledge of biological classification. The applicant should have keyboard skills and some familiarity with computer programming and be a car owner.

The postholder will be employed by the Society (a private Charitable Trust) and will be responsible to a Joint Committee. The person appointed will be given a fixed term contract expiring on the 31 March, 1990.

Salary within the scale £6555-£8262, Scale 4/5.

Further details of the post and an application form are available from The Secretary, Wiltshire Archaeological and Natural History Society, The Museum, 41 Long Street, Devizes, Wiltshire SN10 1NS. Tel: Devizes (0380) 77369. Closing date for applications: 29 April, 1985.

NORTH LONDON BLOOD TRANSFUSION CENTRE, CREAMBROOK ROAD, EDMUND, MIDOX NAB 980

SCIENTIFIC OFFICER

There is a vacancy for a Scientific Officer in the Microbiology Department. Microbiological experience is essential to transfusion specialism would be an advantage. Apply in writing to Administrator, quoting Ref No A49/84, for application form and job description. Closing date: Two weeks from the appearance of this advertisement.

WEST LAMBETH HEALTH AUTHORITY St Thomas' Hospital—Intensive Care Unit

MEDICAL PHYSICS TECHNICIAN—ITU

SALARY SCALE: £6488—£8188 INCLUSIVE

Applications are invited from suitably qualified technicians to join the technical support team in the Intensive Care Unit at St Thomas' Hospital. This challenging post is graded as a MPT IV and is particularly concerned with the basic preventative maintenance, disinfection and repair of the ventilators used in the Unit, together with a range of patient monitoring equipment.

The successful candidate will be expected to build up a close relationship with medical, nursing and other technician staff in the Unit. Participation in an on-call rota will also be required.

The Hospital is within easy walking distance of Waterloo Main Line and Underground stations, and a season ticket loan scheme is in operation.

For further details, please contact the Personnel Department at St Thomas' Hospital on 01-928 9292 extension 2779.

Closing date: 12 April, 1985.

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The best foundation for a successful career in sales and marketing management is a sound sales training and experience with an established and reputable company.

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**Ross Warren
Recruitment**



NORTH EAST SURREY COLLEGE OF TECHNOLOGY TECHNICIAN—DEPARTMENT OF BIOLOGICAL SCIENCES

Salary range £6204-£6702.

Full time technician required in the above department to prepare degree equivalent practicals and project work and be generally responsible for one of the Microbiology Laboratories.

The successful candidate will probably hold an HNC or equivalent and have relevant working experience in Microbiology although candidates with an ONC or equivalent will also be considered. Some knowledge of Immunology also useful.

Monday to Friday, 36 hour week. 20 days annual leave plus 10 statutory holidays.

For application form please send SAE to Personnel Section, NESOCOT, Reigate Road, Ewell, Epsom, Surrey KT17 3DB.

GUYS' HOSPITAL BIOCHEMIST

Applications are invited for a temporary Basic Grade Biochemist in the Department of Clinical Chemistry to cover maternity leave for a period of up to 40 weeks.

The successful candidate will rotate between the various sections of the Department and gain a broad experience in Clinical Chemistry. Applicants must be graduates with an appropriate science degree. Salary scale: £7021-£9809 p.a. inc.

Further details are available from Dr H. Liddell, Consultant Pathologist, or D. P. A. Towse, Top Grade Biochemist 2162 or 216. Application forms are available from the Personnel Officer on 01-407 7600, Ext 3471 quoting ref. P/131.

Closing date for completed applications: 12 April, 1985.

ST MARY'S HOSPITAL MEDICAL SCHOOL (University of London)

Norfolk Place, London W2 1PG

MEDICAL LABORATORY SCIENTIFIC OFFICER— JUNIOR B

Microbiology graduates are invited to apply for a research post to perform enzymatic and conventional tests for the development of methods for rapid identification of bacteria of clinical importance. The post is for 15 months and requires no previous experience. Salary within the range for Junior B MLSC, at age 17 £3812 rising to £5055 plus £1045 London Allowance.

Applications should be in the form of a cv with the names and addresses of two referees and should be sent to the Assistant Secretary (Personnel) at the above address by Friday, 12 April.

THAMES POLYTECHNIC School of Biological Sciences and Environmental Health

POSTDOCTORAL RESEARCH WORKER

Applications are invited for an AFRC funded postdoctoral research worker to work for 18 months with Dr D. J. Beaudet on the amino acid pharmacology of cultured insect neurones. Preference will be given to candidates with experience in electrophysiology.

Salary: £5886-£9048 inclusive p.a. Further particulars and application form from the Staffing Officer, Thames Polytechnic, Wellington Street, London SE18 6PF, to be returned by 23 April, 1985.

Thames Polytechnic is an equal opportunities employer.

The National Gallery

Scientific research on paintings and their environment

You will be carrying out research on the effects of light, humidity and air pollution on paintings. Work will include advising the Director, Trustees and staff; operation and development of apparatus for measuring colour of paintings and of logging systems for collecting data from exhibitions rooms.

You must have a good honours degree, or an equivalent qualification, in physics, physical chemistry or a related subject and should preferably have experience in colour science and in writing and using computer programs. Knowledge of art and picture restoration desirable.

Appointment as Scientific Officer (£7205-£9450 includes £1300 London weighting). Starting salary according to qualifications and experience.

For further details and an application form (to be returned by 19 April 1985) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 468551 (answering service operates outside office hours).

Please quote ref: SB/4/DP.

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University of Cambridge
LOW DIMENSIONAL
STRUCTURES

A university post of Assistant Director of Research in the Department of Physics is available to work on a project studying low dimensional structures grown by molecular beam epitaxy with in situ lithography. Experience in any of the areas of growth or fabrication is desirable together with relevant qualifications. There may be a requirement for occasional teaching duties.

Salary on the scale £10 330 to £14 925 p.a.

Further information concerning the duties and conditions of appointment may be obtained from the Secretary of the Appointments Committee for the Faculty of Physics and Chemistry, Institute of Astronomy, Madingley Road, Cambridge CB3 0HA, to whom applications (no copies) - overseas candidates need send only one copy, including a cv and the names of not more than three referees, should be sent so as to reach him not later than 6 May, 1985.

TECHNICIAN

required to work in the MRC Neuroimaging Project. The work will involve the use of tissue culture and immunohistochemistry methods for research on the nervous system. Experience in either of these techniques would be helpful. Salary in range £599-£7664-£1290 LW. This post is grant supported initially for approx 17 months, but with a possible continuance of a further five years. Applications forms from Personnel Officer (Technical Staff CM11), University College London, Gower Street, London WC1E 6BT.

INSTITUTE OF DERMATOLOGY
(University of London)
SENIOR TECHNICIAN, MASS
SPECTROMETRY UNIT

Applications are invited for the above post. This will include the day to day operation and maintenance of the VG 306 mass spectrometer and its associated gas chromatograph and data system. The equipment is used for qualitative and quantitative analysis of endogenous fatty acids, phospholipids and peptides and the work forms part of a five-year MRC Programme Grant funded project. The salary will be at an appropriate point on the MLBO scale. Applicants should forward a copy of their cv and names of two referees to Dr A. I. Mallet, Institute of Dermatology, Homerton Grove, London E9 6BX (01-985 7061), from whom further details can be obtained.

STUDIOSHIPS

PHARMACY DEPARTMENT AT
THE QUEEN'S UNIVERSITY OF BELFAST

Design of Non-Intrusion only administered Controlled Drug Delivery Systems

Applications are invited for a studentship funded by the SERC under the CASE AWARD scheme

Applicants should have a good honours degree in pharmacy, or other science based degree.

The research project will give the successful applicant an ideal opportunity to work in the active field, where the commercial objective is the development of non-intrusion transdermal systems.

The research will concentrate on the fundamental aspects of the design of controlled release systems where scientific activity will be a key feature.

Applications in the form of a detailed curriculum vitae should be sent to: Professor A. U. Wain, Department of Pharmacy, Medical College Centre, Queens University of Belfast, 97 Lisburn Road, Belfast BT9 7BL, Northern Ireland.

BRUNEL UNIVERSITY
DEPARTMENT OF APPLIED BIOLOGY

Research Studentships - October 1985

Applications are invited for studentships leading to the degree of PhD from undergraduates who expect to gain at least 2.1 degree. The areas of study will be amongst the following:

Breakdown of proteins and other macromolecules, and the roles of free radicals in these processes (Prof Roger Dean, Cell Biology Research Group).

Macrophage Function and low density lipoproteins (Dr Wendy Jessup, Cell Biology Research Group).

Endocrinology of stress responses and reproduction in trout (Dr John Sumpster).

Parasite Immunology (Prof Roland Terry).

Applications (with full cv and names of two referees) should be sent to Prof Roger Dean, Dept of Applied Biology, Brunel University, Uxbridge, Middlesex UB8 3PH, as soon as possible, specifying the area(s) for which they should be considered.

LUDWIG INSTITUTE
FOR CANCER RESEARCH
(London Branch)

Haddow Laboratories,
Clifton Avenue, Sutton,
Surrey SM2 5PX

RESEARCH STUDENTSHIP

Applications are invited for a research studentship, leading to the degree of PhD, to investigate the structure and synthesis of basement membranes by normal and malignant epithelia. The work will require the use of electron microscopy and immunocytochemistry as well as a variety of in vitro cell culture techniques.

The successful applicant will be expected to obtain a first or upper second degree in a biological or biochemical discipline.

The stipend and conditions will be according to the MRC regulations and the post will commence in the Autumn.

Applications with cv and details of two referees should be sent to the Administrator at the above address no later than 30 April, 1985.

UNIVERSITY OF NEWCASTLE
UPON TYNE

Department of Soil Science

MAFF POSTGRADUATE
RESEARCH STUDENTSHIP
NITROGEN IN THE UPLANDS

Applications are invited for a postgraduate studentship tenable from 1 October, 1985. The successful candidate would study the efficiency of nitrogen use in upland grass areas.

Applicants should have, or expect to obtain, a first or upper second class honours degree preferably in an agricultural or biological science. Further particulars are available from Dr R. S. Shiel, Department of Soil Science, The University, Newcastle upon Tyne NE1 7RU. Tel 0632 32841. For applications including cv and the names of two referees should be lodged by 10 May.

UNIVERSITY OF CAMBRIDGE

SCOTT POLAR RESEARCH INSTITUTE

Directional Wave Spectra

Within and Outside an Ice Edge

Multi-sensor remote sensing of polar ice

Applications are invited for a NERC research studentship leading to the PhD degree in one of the above subjects. The former is a CASE studentship between SPRI and Institute of Oceanographic Sciences.

Applicants should possess, or expect to be awarded a good honours degree in physics, applied mathematics, engineering, oceanography or a related subject. Some experience in computer programming, and an interest in the polar regions are desirable.

Please apply, sending CV and the names of two academic referees, to Dr Vernon Spence, Polar Research Institute, Lensfield Road, Cambridge CB2 1LR, from whom further particulars can be obtained.

UNIVERSITY OF LANCASTER
Department of Environmental
SciencePhD Research
Studentships

Approved NERC studentship projects are available in the following areas:

Development of new modelling techniques for simulations and applications to volcanic environment (CASE award with the NERC Institute of Oceanographic Sciences) (Dr C. M. Allen and Dr P. J. Williams).

Monitoring active volcanoes in the Mediterranean area using satellite imagery (CASE award with the Royal Aircraft Establishment) (Dr L. Wilson, Dr H. Pulatovic and Mr M. Bowden).

The flow behaviour of molten silicates - Assemblages and applications to volcanic processes. (Dr H. P. Wilson and Dr L. Wilson).

Applications for Studentships in any of these areas should include a CV and the names of two referees. Write for further details to the relevant structures at the Department of Environmental Science, University of Lancaster, Lancaster LA1 4YQ.

UNIVERSITY OF BRISTOL
Department of GeographyResearch Studentships in
Hydrology

Applications are invited for two research studentships in hydrology, to join an existing team (currently two research assistants and two research students) working on operational flood forecasting models.

The appointments will be for three years, leading to a PhD degree, and there is the possibility of promotion to Research Assistant, Scale 18 (salary according to age, qualifications and experience) in the final year. Candidates should have a first or upper second class honours in both computer and field aspects of hydrology.

Applications, including a curriculum vitae and the names of two referees, should be sent before 16 April, 1985, to Dr M. G. Cresswell, School of Geography at the following address:

Department of Geography, University of Bristol, University Road, Bristol BS8 1BS.

UNIVERSITY COLLEGE LONDON

Department of Physics and
Astronomy

NERC RESEARCH
STUDENTSHIP

Theoretical Astrophysics

Applications are invited for the above studentship which has become vacant but must be filled by 7 June, 1985 at the latest. Applicants must hold a degree with at least Upper Second Class honours in a Physical Science or Mathematics. The work involves the theoretical and computational study of models of variable stars, culled from the observation of Dr D. L. Moore. Applications as soon as possible to Dr D. L. Moore, Dept of Physics and Astronomy, University College London, Gower Street, London WC1E 6BT or Tel 01-387 7050 Ext 391.

School of
Industrial Science

RESEARCH IN MOLECULAR ELECTRONICS

A Case Studentship is available to candidates with a good Honours Degree in a Science or Engineering discipline to work on

Novel Polymer Blends for electrical and optical applications

in conjunction with Plessey Research Caswell Ltd.

Industrially sponsored studentships are also available in Polymer Engineering, High Temperature Corrosion and Water Sciences.

For further details contact Dr. J. P. Chubb, School of Industrial Science, Cranfield Institute of Technology, Cranfield, Bedford MK43 0AL. Tel: 0234 750111 ext. 2529.

School of Industrial Science

Cranfield

JOHN INNES INSTITUTE GRADUATE STUDENTSHIPS IN MOLECULAR BIOLOGY AND CELL BIOLOGY OF PLANTS AND MICROORGANISMS

Eight studentships are offered for prospective PhD students in the four departments of the Institute. The research topics, with the Department in brackets (Applied Genetics, AG; Cell Biology, CB; Genetics, G; or Virus Research, V) are: Immunocytochemical investigation of pea seed development (AG); Signalling ligands involved in transmission of wound response in plants (CB); Molecular biology of transposable genetic elements in *Arabidopsis* (G); Control of expression of symbiotic genes in *Rhizobium* (G); Expression of pathogenicity genes of *Xanthomonas campestris* (G); Analysis of cloned antibiotic and differentiation genes in *Streptomyces* (G); Analysis of plant virus promoters by gene fusion (V); Changes in host gene expression in virus-infected plant tissue (V).

The John Innes Institute is affiliated with the nearby University of East Anglia and graduate students working here are entitled to use all the academic and social facilities of the University as well as the excellent facilities of the Institute.

Prospective applicants should write to the Head of the Department concerned for further details of particular projects. The financial arrangements for the studentships will be the same as those of the usual Research Council Studentships.

THE BOWETT RESEARCH INSTITUTE Bucksburn, Aberdeen AB2 9SB RESEARCH STUDENTSHIP

A research studentship is available at the Rowett Research Institute for work on the amino acid requirements of pigs. Applicants for this studentship should have, or expect to obtain this year, a first or upper second class degree in agricultural chemistry, nutrition or a related subject. The student will normally be expected to work towards a PhD degree (University of Aberdeen).

Letters of application, giving the cv and the names and addresses of two referees, should be sent to the Secretary, The Rowett Institute, Greenburn Road, Bucksburn, Aberdeen AB2 9SB, from whom further details may be obtained. Closing date, 18 April, 1985.

UNIVERSITY OF ST ANDREWS

DEPARTMENT OF PHYSIOLOGY AND PHARMACOLOGY

RESEARCH STUDENTSHIPS

The above Department invites enquiries from prospective Honours students in the Biological Sciences who are considering pursuing a course of training in research methods leading to a higher degree. Enquiries from persons interested in neurobiology, membrane transport or muscle physiology are especially welcome. The Department receives up to six studentships annually, from the Medical Research Council, Science and Engineering Research Council and the Natural Environment Research Council. Please address enquiries, including names and addresses of two referees, to Mrs H. Noble, Secretary, Department of Physiology and Pharmacology, University of St Andrews, St. Mary's Buildings, St Andrews, Fife KY16 9TS. Scotland. Telephone St Andrews (0334) 76161, extension 7136.



**LOUGHBOROUGH
UNIVERSITY
OF TECHNOLOGY**

SERC CASE STUDENTSHIP IN ANALYTICAL CHEMISTRY

Would you like to work for a PhD in a lively and enthusiastic research group on a project involving the development of new analytical methods? In addition to the basic grant, an additional payment of approximately £500 pa will be made to the person taking up the challenge of devising flow injection based methods for the analysis of materials of interest to the co-operating body, BDM Ltd, for a variety of trace components.

If you have a good honours degree in chemistry or a related subject, or equivalent qualifications, and could start by 18 May, 1985 and would like further details, please contact Dr J. F. Tyson, Department of Chemistry, Loughborough University of Technology, Leics., LE11 3TU Tel (0509) 263171 Ext 360.

Loughborough

Leicestershire

UNIVERSITY OF DURHAM DEPARTMENT OF GEOGRAPHY RESEARCH STUDENTSHIPS

Applications are invited from suitably qualified applicants for postgraduate studentships to begin in October, 1985 for:

1) NATURAL ENVIRONMENT RESEARCH COUNCIL

- (i) And zone geomorphological and geological mapping to remote sensing (Supervisors: Dr R. Harris and Mr J. L. Mumford)
- (ii) Moorland and bracken change in the North York Moors using remote sensing (Supervisors: Dr R. Harris and Dr R. W. Brown)
- (iii) Radar remote sensing of moorland in northern England (Supervisor: Dr R. Harris)
- (iv) Interfacing digital cartographic data to environmental information systems (Supervisor: Mr H. J. Blackburn)

2) ECONOMIC & SOCIAL RESEARCH COUNCIL

Participation in SERC's 'Studentship Competition Scheme' (closing date 1 May) to study contemporary aspects of Britain, Europe, the Middle East and Mediterranean. 'Linked Awards' may be announced in these fields in early May.

All enquiries to the Administrative Officer, Department of Geography, University of Durham, South Road, Durham DH1 1TA.

THE UNIVERSITY OF MANCHESTER

Department of Biochemistry

POSTGRADUATE RESEARCH STUDENTSHIPS OCTOBER 1985

Applications are invited for the above position from British undergraduates who expect to obtain a First Class or Upper Second Class Honours degree this summer. Research projects are available within each of the following general areas: Aspects of tumour growth and development, Biochemistry of the extracellular matrix in health and disease, Biomolecular organization, Integration and control of metabolic processes, Protein engineering, Regulation of gene expression, Structure and function of membranes.

Applications containing a cv and the names and addresses of two referees should be sent as soon as possible to Dr John Rossmann, Department of Biochemistry, The University, Manchester M13 9PT.

LECTURES, MEETINGS AND COURSES

ENGINEERING

—IT'S NOT A MAN'S WORLD!

The Polytechnic of the South Bank runs a one-year course for women leading to the Higher National Certificate in Electronics. The course also includes computing and management studies.

If you are under 25 by September 1985 and live in S.E. England you are eligible for a grant from the European Social Fund. Qualifications needed include an A level in maths or physics (or equivalent).

Find out more from the Department of Electrical and Electronic Engineering, Polytechnic of the South Bank (Ref NST), Borough Road, London SE1 0AA. Tel 01-928 9898, Ext 2261.

POLYTECHNIC OF THE SOUTH BANK

HERIOT-WATT UNIVERSITY

DEPARTMENT OF OFFSHORE ENGINEERING

Research Studentship

Applications are invited for a Research Studentship in the areas of:

- I Non-destructive and Corrosion testing using laser techniques.
- II Computer control of Remotely Operated sub-sea Vehicles (ROVs). The ROV project will involve wind tunnel and wave tank testing.

Applicants who expect to obtain a First Class or Upper Second Class Honours Degree in Science or Engineering are asked to make immediate application to Dr I. Grant, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS.

Department of Chemistry



**Southampton
THE
UNIVERSITY**

MSc in Electrochemical Science

This course, run by one of the largest electrochemistry groups in Europe, is approved by the SERC for the award of advanced studentships.

Students gain first hand experience of electrochemical techniques, and a broadly based lecture course provides the necessary background. Areas of application include battery systems, chemical sensors, corrosion control and semiconductor technology.

Further details can be obtained from Dr L. M. Peter, Department of Chemistry, The University, Southampton SO9 5NH, UK.

MSc IN OPTOELECTRONICS (CNAAC)

This course covers the physics and wide-ranging applications of many Optoelectronic devices.

The course programme initially covers topics such as: Solid State Physics, Laser Physics, Fibre Optics, Digital Electronics and Computing. Students then take a compulsory module in Optoelectronic devices with an emphasis on applications in Fibre Optic Communications and two of the following modules: High Frequency Engineering, Laser Processing, Image Processing, Signal Processing. Finally students undertake a fifteen week project in an industrial or government establishment.

A number of Science and Engineering Research Council Advanced Course Studentships are available. Students who hope to obtain a good Honours degree in Physics or Electrical and Electronic Engineering (or related subjects) can obtain further information and application forms from:

Mrs MA Davidson
Faculty of Engineering
Newcastle upon Tyne Polytechnic
Elision Place
Newcastle upon Tyne
NE1 8ST
Telephone (0632) 326002

NEWCASTLE UPON TYNE
POLYTECHNIC

Cranfield

Applied Energy Group
School of Mechanical Engineering
CRANFIELD Institute of Technology
Bedford MK43 0AL

Have you considered specialising in Energy?

Vacancies still exist for students wishing to undertake the following courses starting in October 1985:

- 1 or 2 year MSc course "Energy Conservation and the Environment".
- 2-year Dipl Ing and MSc double-degree course "Energy Studies". (in conjunction with the University of Technology, Compiegne, France).
- 1 or 2 year MSc course "Energy and Buildings".

These popular courses provide training for Engineers, Architects, Surveyors, Physicists, Mathematicians and Environmental Scientists in the effective use of energy. SERC Advanced Course Studentships or Bursaries are available for suitably qualified candidates.

For further information please contact Professor Douglas Probert, (Ref 1129), Tel 0234-750111, Ext 2302.

OPTOELECTRONIC AND LASER DEVICES

MSC HERIOT-WATT UNIVERSITY & ST ANDREWS UNIVERSITY

Offered as a one-year full-time course of two/three years part-time experience at two universities plus industrial project work, the course is tailored to the needs of the fast-developing Optoelectronics Industry. SERC Advanced Course Studentships available.

Further details and application forms from: Dr B. S. Wherrett, Department of Physics, Heriot-Watt University, Edinburgh EH14 4AS.

Telephone 031 5111, Extension 2223.

READING UNIVERSITY
BIOMECHANICS GROUP
and
CAMDEN FOOD PRESERVATION
RESEARCH ASSOCIATION

present a three-day course on

TEXTURE OF FOODS

at the University of Reading, July 1985

The mechanical and fracture properties of foods will be described and analysed using a standard materials science approach.

The course will run from the evening of July 8 until July 11 and cost £200 (inclusive of accommodation and meals). For further details write immediately to Dr J. F. V. Vincent, Biomechanics Group, The University, PO Box 228, Reading RG6 2AJ. Tel 0734 875123 Ext 7405.

FELLOWSHIPS, GRANTS & SCHOLARSHIPS

UNIVERSITY OF LEICESTER
DEPARTMENTAL RESEARCH
SCHOLARSHIPS

Applications are invited for six Postgraduate Departmental Research Scholarships tenable at the University of Leicester from 1 October, 1985.

Scholarships tenable for up to three years are available in each of the following Departments: Archaeology, Geography, Law, Psychology. Scholarships tenable for a maximum of two years are available in the Department of History and of Mathematics.

Scholarships carry an annual maintenance award of £2885 (under review) plus remission of fees where scholars are to register for studies at the University. Departmental Research Scholars will be expected to carry out 10 hours tutorial supervision or 16 hours laboratory demonstrating per week for which payment will be made at the rate of £9.65 per hour (tutorial supervision) or £5.65 per hour (laboratory demonstrating). These rates are currently under review. Scholars undertaking research for the first time will not be expected to carry out more than six hours supervision or demonstrating per week in their first year.

Further details and application forms are available from the Registrar (Departmental Research Scholarships), University of Leicester, University Road, Leicester LE1 7RH, to whom applications should be returned by 3 May, 1985. When requesting further details please specify the subject area proposed research.

UNIVERSITY OF READING
Department of Chemistry
POSTDOCTORAL RESEARCH
FELLOWSHIP

Applications are invited for a University Postdoctoral Research Fellowship to work under Professor R. M. Prev to investigate the Kinetics of Free Radical Reactions in the Gas Phase by laser and other spectroscopic techniques. Previous experience in this or a closely related area is essential. This fixed term three year fellowship will commence as soon as possible. Starting salary up to £3600 pa, plus US\$450 per year. Applying for application forms (two copies) to Personnel Office, University of Reading, Whiteknights, PO Box 217, Reading RG6 2AH. Tel (0734) 875123, Ext 233.

UNIVERSITY COLLEGE LONDON

JOINT RESEARCH SCHEME

WITH ICI NEW SCIENCE GROUP

Applications are invited for a post-doctoral research fellowship to study reaction pathways of molecules in zeolites. The project, which is a collaborative one between the Chemistry Department, UCL and ICI New Science Group, will use computational quantum chemical techniques. The post will be for three years commencing on or before 1 October, 1985. Applications, enclosing a cv and names and addresses of two referees, should be addressed to Dr R. Catlow, Department of Chemistry, University College London, 20 Gordon Street, London WC1H 0AJ from whom further details are available.

THE BREWERS' SOCIETY

SCHOLARSHIPS

Applications are invited from graduates, and final year students expecting to obtain a First or upper second-class degree in a suitable discipline (e.g. chemistry, biochemistry, chemical engineering or biological science) for training in brewing science at either Heriot-Watt or Birmingham University.

Scholarships are available to undertake a Diploma, MSc or PhD at Heriot-Watt, or an MSc or PhD at Birmingham. Having obtained one of these postgraduate qualifications, candidates would be expected to take up positions in the brewing industry.

Applications for awards including the names of two referees and indicating the University of choice should be addressed to Dr D. E. Long, Deputy Technical Secretary, The Breweries Society, 42 Portman Square, London W1H 0BB.

UNIVERSITY CHEMICAL

LABORATORY, CAMBRIDGE

POSTDOCTORAL RESEARCH

FELLOWSHIP

Applications are invited for a two-year Science and Engineering Research Council postdoctoral fellowship to work with Professor Sir Jack Lewis and Dr B. F. O. Johnson on the chemistry of metal clusters.

IA Salary Scale: £7800-£9300 pa.

Further particulars may be obtained from Professor Sir Jack Lewis, University Chemical Laboratory, Lensfield Road, Cambridge CB2 1EW.

APPOINTMENTS

WANTED

ETHOLOGIST: PhD, two year postdoc, six year college lecturer seeks temporary escape back to research for one year's academic leave. Box D866.

SERVICES

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contact Ingatstone Translations, 37 High Street, Ingatstone, Essex CM4 0AT. Tel (0277) 353663 and 354022.

BOOKS AND PUBLICATIONS

BRAND NEW SCIENTIFIC TEXT

BOOKS for sale, half price. For free list Tel 01-830 8246.

PERSONAL

SCHOOL OF HYPNOSIS

Diploma Course 01-359 6991.

ARIADNE

AT THE height, or depth, of the excitement about flying saucers, a British merchant ship was a day's sailing out of New York. Early in the morning, the radio officer (an erstwhile colleague of mine who told me the story) was hooked out of his bunk to go on the bridge. Outside, pitch darkness. Inside, a ghostly green glow from the radar display, figures bending over it in silence. "What do you make of that?" asked the captain, indicating a blip on the screen. Studying the blip in the uncanny silence and light, the radio man was mystified. The thing was moving, approaching the ship. But it was moving slower than any fixed wing aircraft and faster than any ship. It was far outside the range of a helicopter, coming in from the Atlantic.

The group watched, skin beginning to crawl and hairs beginning to elevate on the backs of necks. The blip headed straight for the vessel. My informant will not swear to it, but he thinks that a number of breaths were being bated as the blip got nearer and it became clear that their ship was a target. The flying object was, in moments, overhead. The brave among the group rushed outside. Immediately they were bathed in glaring white light. From a searchlight on a US Coastguard blimp.

This anecdote came to mind as I watched an airship nosing about over London recently. It was casting about like a slow, fat dog, a rotund, genial form, with not a hint of menace. Somehow there is nothing sinister about such craft. It made me feel cheerful as the spring sunshine glistened on its skin. I was also reminded of the first time I saw the shape of a Boeing 707, flitting in and out of low cloud over the Cotswolds. That produced a primitive reaction near to terror. Birds crouch motionlessly, I am told, reacting to the outline of a hawk. I seem to be strictly for the birds. □

IT IS generally unrewarding to comment on comment, but I admit to some provocation from a book review in our contemporary, *Nature*. The book concerned is called *In Search of Schrödinger's Cat: Quantum Physics and Reality* by John Gribbin, the review by P. W. Atkins, a Fellow of Lincoln College, Oxford.

After some complimentary remarks, the reviewer says that, all the same, he does not approve of the impact the book might have had, on the grounds that, in the interest of better journalism, Gribbin goes in for what he calls "awe". This, apparently, is wrong, tantamount to abnegating the scientist's duty "to seek truth in simplicity".

I should have thought that, if the Universe can ever be described in perfectly simple terms that would be an excellent reason for awe. □

EVERYBODY in the country, as far as I can judge, has a hole-in-the-road horror story. You can't get a word in edgewise if you mention the subject. It is probably the same the world over and even now outrage is deafening the drinkers at a party in Duluth and turning the guests purple round the dinner table in Canberra.

After my mention of the LEB dancers leaping up and down, like Lords at Christmas, to level a tarmac repair, I am a little more optimistic about the technology, though. The Gas Board has a different technique, I find.

Watching a North Thames Gas operation of filling in two-month-old holes, I saw the shovelled earth being smoothed over mechanically. The shovellers' van was run backwards and forwards over it a few times, with much roaring of engine. The result was a surface as smooth as that of an approach road to the front in Flanders in 1915. □

WE CAN all agree, I trust, on a virtuous use for cruise missiles. Not that I have thought of it, though I wish I had. It originates with Dr David Whitehouse, who works at the Mullard Space Science Laboratory. He points out that a cruise missile has ideal characteristics that make it a thoroughly attractive proposition for planetologists. It can fly long distances while hugging any type of terrain, so it could be used to explore the surface of Mars, one of the most interesting bodies in the Solar System.

The planet's surface area is about the same as the land area of Earth. What we know about it already comes from the results of soft landings by Vikings 1 and 2 in 1976 and from the Viking orbiter, which sent back thousands of high-quality pictures confirming Mars, in Whitehouse's words, "as a world of wonders, with craters, enormous canyons, deserts with sand dunes and giant extinct volcanoes that are occasionally buried up to their necks in cloud".

Up to now, the favoured method of continuing the planet's exploration has been to use a "Mars Rover", a semi-automatic mobile platform. But this could crawl only a kilometre or so a day. A cruise probe could fly a few hundred metres over the surface for thousands of kilometres even if it could operate for only a fraction of the time available to a Mars Rover.

Whitehouse's dream is of a whole fleet of cruise probes, released from a Mars orbiter and "traversing the ramparts of Nix Olympia, flying over the Elysium plateau, over the polar caps or along the dramatic valley of the Mariners", transmitting torrents of information on the wing. □

THE WIND lifts over high hills and mountains, condensing its water vapour into clouds and rain. Clearly, says Daedalus, it has sufficient energy to dehu-



modify itself. Since about four tonnes a day of wind-borne water vapour pass through every square metre of atmospheric cross section, a very modest windmill-dehumidifier could easily supply a household with all its water. Daedalus's cunning new dehumidifier uses modern microencapsulation technology, by which tiny droplets of liquid can be enclosed in thin polymer membranes. Daedalus will microencapsulate strong calcium chloride solution with a thin but resilient material of semipermeable membrane. The resulting membrane-coated microdroplets will be spread onto a loop of fabric, Daedalus's "hygroller-towel". This will be exposed to the air, and passed continuously through a pair of high-pressure pinch-rollers.

Strong calcium chloride solution is very hygroscopic. So the microdroplets will rapidly take up water vapour from the air. As they pass through the pinch-rollers they will be squeezed under high pressure. By reverse osmosis, pure water will be squeezed out of them, freeing them to take up more. Thus the hygroller-towel will absorb water continuously from the air, and be continuously "wrung out" again.

To reach as much air as possible, Daedalus's windmill-dehumidifier will use tensioned hygroller-towels as its blades. Their rotation around the main hub will drive their slower lengthwise "conveyor-belt" transport round each blade. Pinch-rollers at the hub will then deliver endless, effortless, membrane-filtered pure water.

At once, all water-supply problems will be solved. Leaking pipes and inadequate reservoirs will no longer matter. Every house and farm and caravan will have its own free source of water. Desert dwellers and travellers will be freed from their main anxiety, and the world's tropical paradises will be truly habitable at last. Only plumbers and water-diviners will complain. □

THE COMET IS COMING!



Win
some
astronomical
prizes
in New Scientist's
SERC/BAYS
essay
competition

HALLEY'S COMET will become visible in our skies next year as it approaches the Earth on its 76-year orbit. In the past, the comet's visits have provoked all kinds of reactions, ranging from scientific curiosity to superstitious panic. Astronomers wanting to study the comet were limited by the observing facilities available to them; and of course their telescopes were on the ground. Now, for the first time, astronomers can observe Comet Halley at close quarters by means of spacecraft which can fly past the comet and send back to Earth detailed information on its composition.

In July, the European Space Agency will launch its Giotto spacecraft. The mission is intended to encounter the comet in March 1986 and to skim past its nucleus. Information from Giotto, together with data from the American, Soviet and Japanese missions to Comet Halley, will be used by astronomers throughout the world to build up a detailed picture of the comet.

The European Space Agency is offering a trip to its launch site in Kourou (French Guiana) for the launch of Giotto as first prize in a competition sponsored by the Science and Engineering Research Council, *New Scientist* and the British Association Young Scientists.

Write an essay describing either:

- how you plan to observe Halley's Comet, and what sort of experiment(s) and observations you would carry out if you had

access to scientific facilities (optical, infrared or radio telescopes, interplanetary probes, and so on)

or:—some aspect of the history of Comet Halley's appearances and the various reactions to it—popular reaction, earlier scientific studies and so on.

The competition is open to anyone aged between 13 and 20 on 1 July 1985. The writer of the winning entry (the judges will take entrants' ages into account) will be offered a trip to Kourou for the Giotto launch, and the ten runners-up will receive a year's subscription to *New Scientist*. The writers of the best two essays will also receive free invitations to attend the Glasgow meeting of the British Association for the Advancement of Science in August. The names of the first and second prizewinners will be announced in *New Scientist* on 6 June, and provided the winning entry is of sufficient merit it will be published in this journal.

Entries should be typed or written in English, using only one side of the paper and double-line spacing. On the top left-hand corner of the first page give your full name and address and date of birth. Put your name on every sheet. The competition closes on 16 May 1985.

Post your entry to Karen Iddon, Room 114, *New Scientist*, Commonwealth House, 1-19 New Oxford Street, London WC1A 1NG.

newscientist

VIDEOS



Created to give a better picture of the issues of today.

THE BIO-BOMBSHELL

The growth of the bio industry is told in this video story of the latest and most far-reaching revolution in science.

The Bio-Bombshell shows how genetic engineering has enabled us to 'design better bugs and cells to do specific jobs, give us new foods, vaccines, drugs, fuels and chemicals, alleviate pollution, create more efficient crops and livestock and combat genetic deficiencies and diseases.

But biotechnology raises new moral dilemmas. Is it right to tamper with nature? What are the dangers? How will the future of man-made life be controlled? Plus a 36 page Fact File of nine worksheets designed to complement and amplify the cassette.

INFORMATION TAKEOVER

The future and implications of Information Technology, or IT as it is widely called, are described in this video with the sinister title Information Takeover.

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